The Marine Life Information Network for Britain and Ireland (MarLIN)

Assessing seabed species and ecosystems sensitivities.
Existing approaches and development.

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PREFACE

THE MARINE LIFE INFORMATION NETWORK FOR BRITAIN & IRELAND

MarLIN

Information to support marine environmental management, protection and education.

Description of the programme.

The Marine Life Information Network for Britain and Ireland (MarLIN) is an initiative of the Marine Biological Association of the UK in collaboration with major holders and users of marine biological data and information.

MarLIN:

- provides a structure for linking available data on marine life around Britain and Ireland;
- improves the access, display and interpretation of information in support of environmental management, protection and education, and
- is developing the most comprehensive, easily used source of information about marine habitats, communities and species around Britain and Ireland and their sensitivity to natural events and human activities.

MarLIN has a Core Network Team and three sub-programmes:

1. The Seabed Data Acquisition Sub-programme. The major starting point for this sub-programme is the Marine Nature Conservation Review (MNCR) database which holds data from over 30,000 locations. Data sets from a wide variety of sources will be linked to the MNCR database, concentrating especially on offshore areas and the seas to the west of Britain. The data will be capable of interrogation to map species and biotope distributions as well as to interpret new data by identifying which biotopes they represent, displaying contextual information and accessing illustrations. This sub-programme contributes essential contextual information for National Biodiversity Network recording.

2. The Biology and Sensitivity Key Information Sub-programme. Biotopes and species pages will provide information about their biology and environmental preferences and to assist in identifying sensitivity and recoverability in relation to natural events and human activities. A graphical, web-based user interface enables the enquirer to identify areas of interest and ask whether any species known to be sensitive, of marine natural heritage importance etc. are present at a location. Hypertext links will access information describing statutes, directives, international conventions and key literature sources.

3. The Biological Recording Centres and Education Sub-programme. This sub-programme links especially to the National Biodiversity Network. It will develop marine biological recording through local recording centres and using volunteer recorders. It will realise the educational opportunities offered by access to images and descriptions of biology of communities and species together with their geographical distributions.

More information on MarLIN can be found on www.marlin.ac.uk
MarLIN: Assessing seabed species and ecosystems sensitivities. Existing approaches and development
The Marine Life Information Network for Britain and Ireland (MarLIN)
Assessing seabed species and ecosystems sensitivities.
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The Marine Life Information Network for Britain and Ireland (*MarLIN*)

Assessing seabed species and ecosystems sensitivities.

**Existing approaches and development.**

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1. **Assessing ‘sensitivity’ – aims and approaches**

The Biology and Sensitivity Key Information Sub-programme aims to:

*Identify key information on the biology and sensitivity of seabed habitats, biotopes and species that can be applied in a practical way to environmental protection and management.*

Assessment of habitat, community or species ‘sensitivity’ includes the appraisal of the likely damage from an activity, the potential for recovery after damage and their importance from the point-of-view of maintaining marine natural heritage importance.

This work is being undertaken by the Marine Life Information Network (*MarLIN*) team at the Marine Biological Association of the UK. The Biology and Sensitivity Key Information Sub-programme will take account of existing schemes for assessing sensitivity and the results of workshops as well as trialing these different approaches. The approaches used will be developed in collaboration with the technical Sub-programme Management Group of *MarLIN*. The Objectives and Guiding Principles for the Biology and Sensitivity Key Information Sub-programme are given in Appendix 1.

Technical terms and jargon need to be minimised to provide a practical and user friendly approach. However, precision in the use of terms is essential, especially in gathering key information. All terms used within the programme will be clearly defined. A glossary of terms used presently is shown in Appendix 2 and acronyms listed in Appendix 3.

2. **Review of recent approaches to assessing ‘sensitivity’**

All systems for assessing sensitivity of wildlife to human activities or identifying locations that are sensitive have their advantages and disadvantages. Most are tailored to the sort of information that is available for an area, habitat, species or activity at the time the system was devised. Appendix 4 presents an assessment of the strengths and weaknesses of the approaches that have been developed including systems that are used today in response to development proposals or accidents such as oil spills. Particular attention is drawn to the work of Holt *et al.* (1995, 1997) which thought through a lot of the concepts of sensitivity, vulnerability, recoverability and intolerance developed further here.

Although it is possible to define sensitivity in fairly precise terms, more pragmatic approaches have been used in preparing environmental assessments over the past twenty years or so. For the seashore and seabed, these approaches usually identify sensitive areas with particular shore types (because of links to self-cleaning following oil spills), with areas of landscape importance, with mariculture activities, with recreational activities and with sites scheduled as of nature conservation importance (but often not differentiating marine wildlife from other importance such as geological features or terrestrial only features).
One of the earliest attempts to assess sensitivity in an objective way was the ‘oil spill vulnerability index’ developed by Gundlach & Hayes (1978). The index has been an important starting point for preparing many sensitivity maps related to oil spills but is based mainly on likely persistence of oil in relation to shore type. Such ‘surrogates’ for sensitivity have been used for a long time as a ‘shortcut’ or ‘best possible’ approach. Even very recent electronic systems for identifying likely sensitivity of locations to prepare oil spill contingency plans use ‘shore-type’ mapping and the location (in Britain) of Sites of Special Scientific Interest as indicators of sensitivity. The system is probably best developed in the USA and there are several Web-sites describing and illustrating the approach (for instance, Michel & Dahlin1993 as updated in Research Planning Inc. 1998). These approaches are different to the ones being developed here which rely on information on the biology and structure of habitats, biotopes and species. This information will help to identify their fragility, susceptibility to contaminants or other factors and their ability to recover once damaged or lost.

Trying to ‘adopt-and-adapt’ from terrestrial approaches to identifying sensitivity and importance, whilst desirable for consistency, may not work in the sea. Criteria used to identify biotopes and species in terms of ‘risk of extinction’ (IUCN 1994) rely on quantitative information being available on recent population decline, on extent of occurrence in km² world-wide or on numbers of mature individuals known to be alive. Almost all marine species would fall into the IUCN Red List ‘Data Deficient’ category and so ‘risk of extinction’ is not a relevant category for seabed species. However, Von Nordheim, Anderson & Thissen (1996) have defined ‘threat categories’ for biotopes in the Wadden Sea area which use the sort of information resources which we have for at least some marine biotopes and species (Box 1). The categorisation of species or biotopes as extinct or threatened to various degrees is most useful in considering ‘importance’ for conservation of marine natural heritage rather than as an indication of sensitivity in the definition used here.

**Box 1.**

Threat categories developed for populations of taxa in the wild that are or have been reproducing regularly and whose populations are extinct, presumed extinct or have become endangered in a certain survey area within the past 10-100 years. From Von Nordheim, Anderson & Thissen (1996) for the Wadden Sea area.

EX – extinct or presumed extinct (disappeared from the area)

CR – Critical (Under immediate threat of extinction).

EN – Endangered

VU – Vulnerable

SU – Susceptible

* - Not Endangered

IR – International Responsibility

Whilst the threat of oil pollution has initiated much of the work on sensitivity, fisheries probably poses a much greater threat to marine habitats and species. Recognising that fisheries have a significant effect on marine ecosystems, the International Council for the Exploration of the Seas (ICES) undertook a series of workshops. Their conclusions provide a starting point to identify likely environmental factors or perturbations that will result from mobile bottom fishing gear (Box 2).

Since about 1994 in Britain and Europe, there has been considerable activity to develop more objective approaches to assessing sensitivity of marine habitats and species to human activities and natural events. The nature conservation agencies in Britain have commissioned several of the exercises shown in Appendix 4 (notably, Holt et al.1995, 1997; Anderson & Moore 1997) and have particularly addressed how the different elements determining likely impact of activities (for instance, frequency of the event, likelihood of the event, severity of the event) can be incorporated into a formula (MacDonald et al 1996; Cooke & McMath 1998). The opportunity
to develop some of the approaches to assessing sensitivity incorporating recoverability in relation to the importance of life cycles was taken at a meeting organised by the Marine Biological Association in 1997 (Hiscock, 1999) and several of the points made in that paper are included in the methods being developed here. The IMPACT working group of the Oslo & Paris Commissions (OSPAR) also initiated a significant workshop in the Netherlands in 1997 (OSPAR 1997) and the UK prepared reviews of literature on the role of different habitat types in the ecological functioning and the integrity of marine and coastal ecosystems for the IMPACT ’98 meeting. Furthermore, literature reviews undertaken for the UK Marine SACs project (various authors) and the key information reviews prepared for some UK Biodiversity Action Plan species all itemise information on likely sensitivity and recoverability of biotopes and species. There are now reviews for 16 habitats (Jones et al. 1999) prepared to the style developed for OSPAR IMPACT and MarLIN.

Box 2.
Likely impact of mobile bottom fishing gear (ICES Working Group on the Ecosystem Effects of Fisheries 1994)

- Substratum removed to leave inhospitable habitat.
- Hard substrata having fragile slow growing species may be broken-up, abraded or overturned.
- Reefs of slow growing species providing a biological substratum for other species may be destroyed.
- Biological reefs or consolidated hard substrata overturned/destroyed but capable of rapid re-colonisation after disturbance ceases.
- Re-suspension of silt followed by sedimentation nearby or at a distance.
- Sediment compaction.
- Substratum structure and composition changed producing a ‘new’ habitat.

The various approaches described above and in Appendix 4 were taken into account in developing the sensitivity and recoverability scales trialled in this project. These scales are described in Section 9.

In all of the recent approaches, the main factors causing likelihood of an impact occurring and its probable importance for the destruction of or damage to habitats and species have been established. However, the system for assessing sensitivity and recoverability (which is a part of the project described here) and how to represent all of the elements that identify degree of impact into one ranking (which is not being considered in this project) are not generally agreed.

A popular way to summarise the impact of an activity on a community is to use some form of ordination analysis such as Multi-Dimensional-Scaling (MDS) (see Figure 1). Experience gained from monitoring the impact of accidents and from experimental studies should indicate the severity of the effect of the factors on the community and the timescale for recovery. However, if information from MDS analysis is to be used in the approach MarLIN is developing, the species ‘driving’ the change have to be identified.

3. Recent developments which assist sensitivity assessment

Assessing ‘sensitivity’, ‘recoverability’ and ‘importance’ requires the use of classification systems and rules. Only by having such structures and rules can we expect to begin to access information in an ordered way and understand a bewilderingly complicated world. The structures and rules which particularly help to assess sensitivity, recovery and importance are:

Directory of human activities likely to cause change. The JNCC Marine Information Team uses a list of keywords for activities. In addition, Cooke & McMath (1998) provides a catalogue of activities derived from the Marine Conservation Handbook (Eno 1991) which has been
developed by staff in the nature conservation agencies. The *MarLIN* programme has adopted a list of activities modified from the above sources (Box 3).

**Natural events likely to cause change.** The literature on effects of natural events, particular extreme events, remains scattered and will be indexed as a part of this project.

**Species directories.** Catalogues exist for particular groups in various keys and guides and there is a marine species directory for Britain and Ireland (Howson & Picton 1997). A European Register of Marine Species (ERMS) is currently being compiled with the support of funds from the EC (project led by Dr Mark Costello, Ireland).

**Biotope classification.** In the past five years or so, significant progress has been made in identifying and classifying the biotopes (habitats and their associated communities) present on the seabed. Such classifications give us the ability to compare like-with-like in assessing features such as species richness and to gauge the extent and frequency of occurrence of the resource (for instance, to assess whether a biotope should be considered ‘rare’, ‘scarce’ or ‘uncommon’). Deliberations within the ICES Benthos Working Group and now the ICES Marine Habitat Committee, as well as other fora, are being taken into consideration in developing the marine component of the European Union Nature Information System (EUNIS) classification. European marine biologists have already contributed significantly to developing the classification for inshore areas of Britain and Ireland under the EC Life-funded BioMar project (Connor et al. 1997a & b). OSPAR will undertake development of a biotope classification for the NE Atlantic in the autumn of 1999 including work which is required to develop a biotope classification for deep water areas of the Britain and Ireland EEZ.

**Indices of sensitivity and recoverability.** Criteria and indices have been developed in studies commissioned by the nature conservation agencies and workshops held under the auspices of the ICES Benthos Working Group and OSPAR IMPACT. The character of these systems and their utility is reviewed in this report. Key terms and their definitions are shown in Box 4.

**Criteria to assess the ‘importance’ of wildlife for the conservation of biodiversity.** Protocols for assessing the relevant importance of sites have been developed by a wide range of organisations and are reviewed, for instance, by Hiscock (1997). Some of the main ones that are
practical to apply are listed in Section 6. Criteria for the identification of nationally rare and scarce species and biotopes have been developed by Sanderson (1996) and are described below.

**Box 3.**

Categories of human activity or natural events which may affect marine ecosystem (adapted from Cooke & McMath 1998; Eno 1991).

<table>
<thead>
<tr>
<th>Aquaculture: algae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquaculture: fin-fish</td>
</tr>
<tr>
<td>Aquaculture: shellfish</td>
</tr>
<tr>
<td>Climate: current change</td>
</tr>
<tr>
<td>Climate: sea level change</td>
</tr>
<tr>
<td>Climate: temperature change</td>
</tr>
<tr>
<td>Climate: weather pattern change</td>
</tr>
<tr>
<td>Coastal defence: barrage</td>
</tr>
<tr>
<td>Coastal defence: dredging</td>
</tr>
<tr>
<td>Coastal defence: groynes</td>
</tr>
<tr>
<td>Coastal defence: sea walls</td>
</tr>
<tr>
<td>Collecting: algae/kelp harvesting</td>
</tr>
<tr>
<td>Collecting: bait digging</td>
</tr>
<tr>
<td>Collecting: curios</td>
</tr>
<tr>
<td>Collecting: eggs</td>
</tr>
<tr>
<td>Collecting: higher plants</td>
</tr>
<tr>
<td>Collecting: peelers (boulder turning)</td>
</tr>
<tr>
<td>Collecting: shellfish</td>
</tr>
<tr>
<td>Development (coastal/land): dock/port facilities</td>
</tr>
<tr>
<td>Development (coastal/land): land claim</td>
</tr>
<tr>
<td>Development (coastal/land): urban</td>
</tr>
<tr>
<td>Development (marine/offshore): artificial reefs</td>
</tr>
<tr>
<td>Development (marine/offshore): communications cables</td>
</tr>
<tr>
<td>Dredging: (navigational/maintenance)</td>
</tr>
<tr>
<td>Energy generation: (power stations)</td>
</tr>
<tr>
<td>Energy generation: (wind/wave/tide)</td>
</tr>
<tr>
<td>Extraction: maerl</td>
</tr>
<tr>
<td>Extraction: oil/gas</td>
</tr>
<tr>
<td>Extraction: rock/minerals (coastal quarrying)</td>
</tr>
<tr>
<td>Extraction: sand/gravel</td>
</tr>
<tr>
<td>Fishing: angling</td>
</tr>
<tr>
<td>Fishing: netting</td>
</tr>
<tr>
<td>Fishing: potting/creeling</td>
</tr>
<tr>
<td>Fishing: spear fishing</td>
</tr>
<tr>
<td>Fishing: suction dredging</td>
</tr>
<tr>
<td>Fishing: trawling</td>
</tr>
<tr>
<td>Predator control:</td>
</tr>
<tr>
<td>Recreation: dive site</td>
</tr>
<tr>
<td>Recreation: marina</td>
</tr>
<tr>
<td>Recreation: popular beach</td>
</tr>
<tr>
<td>Recreation: resort</td>
</tr>
<tr>
<td>Recreation: water sports</td>
</tr>
<tr>
<td>Removal of substratum:</td>
</tr>
<tr>
<td>Uses: animal sanctuaries</td>
</tr>
<tr>
<td>Uses: archaeology</td>
</tr>
<tr>
<td>Uses: boats/ships</td>
</tr>
<tr>
<td>Uses: coastal farming</td>
</tr>
<tr>
<td>Uses: coastal forestry</td>
</tr>
<tr>
<td>Uses: education/interpretation</td>
</tr>
<tr>
<td>Uses: military</td>
</tr>
<tr>
<td>Uses: mooring/beaching/launching</td>
</tr>
<tr>
<td>Uses: research</td>
</tr>
<tr>
<td>Waste: industrial effluent discharge</td>
</tr>
<tr>
<td>Waste: litter and debris</td>
</tr>
<tr>
<td>Waste: sewage discharge</td>
</tr>
<tr>
<td>Waste: spoil dumping</td>
</tr>
<tr>
<td>Water supply</td>
</tr>
</tbody>
</table>

**Box 4.**

Key definitions.

`Sensitivity` is the intolerance of a habitat, community or species to damage, or death, from an external factor (based on McLeod 1996). Sensitivity must be assessed relative to change in a specific environmental factor.

Vulnerability’ expresses the likelihood that a habitat, community or species will be exposed to an external factor to which it is sensitive. Degree of ‘Vulnerability’ therefore indicates the likely severity of damage should the factor occur at a defined intensity and/or frequency.

`Recoverability’ is the ability of a habitat, community or species to return to a state close to that which existed before the development, activity or event. Recovery may occur through re-growth, re-colonisation by migration or larval settlement from undamaged populations or re-establishment of viability where, for instance, reproductive organs or propagules have been damaged by the event. Recovery can be partial or complete.

`Importance’. In the context of marine natural heritage: species or biotopes which are rare or very restricted in their distribution; species or biotopes that are in decline or have been; species or biotopes where a country has a high proportion of the regional or world population or extent; species that are keystone in a biotope by providing a habitat for other species; biotopes with a particularly high species richness; locations or biotopes that are particularly good or extensive representatives of their type. Species will also be ‘important’ if they are listed for protection on statutes, directives and conventions.

`Factor’. A component of the physical, chemical, ecological or human environment that may be influenced by natural events or anthropogenic activity.

`Activity’ (maritime). An anthropogenic operation or activity which occurs in the marine or coastal environment (Cooke and McMath 1998).
4. What is ‘sensitivity’?

In definitive terms, ‘sensitivity’ is the intolerance of a habitat, community or species to damage, or death, from an external factor. A habitat, community or species becomes ‘vulnerable’ to adverse effect(s) when the external factor is likely to happen. For instance, a crab might have a high sensitivity to physical impact but is only vulnerable if activities such as scallop dredging are being undertaken where it is present.

Sensitivity might be because of fragility in relation to physical impact, or might be because of intolerance to certain environmental conditions such as extremes of sunshine, temperature, turbidity or salinity or to dissolved contaminants or hypoxia. Identifying sensitivity of habitats and communities may be through the physical fragility of those habitats but is usually determined by assessing sensitivity of component species as adults.

As environmental impact studies are undertaken in relation to different activities and events, our knowledge base expands to facilitate the development of indices based on both sensitivity and potential for recovery. An early example of providing information which helps in assessing likely impact of events is the account of the effects of the very cold 1962-63 winter on marine fauna (Crisp 1964). More recently, the changes following oil spills have been studied in many areas although rarely disseminated in a way that helps assessment of sensitivity and recovery potential. One exception is the description by Dauvin (1991) of changes in sediment benthos off Brittany following the Amoco Cadiz oil spill (Figure 1).

Physical disturbance is another perturbation for which some systematic studies of recovery following an event have been undertaken. For instance, Kenny & Rees (1996) describe the temporal changes in benthic communities at dredged sites compared to reference sites nearby, and Kaiser & Spencer (1996) describe the impact of bottom trawls on benthos. An illustration of the effects of beam trawling is given in Figure 2. Progress has been made in recent years particularly in identifying and indexing sensitivity in relation to impact from mobile fishing gear, incidents of oil pollution and the wider activities occurring during oil exploration and development. A small number of species can be identified as highly sensitive and unlikely to recover from damage. However, work is still required on the concepts of sensitivity and bringing together the information required in order to assess sensitivity at particular locations.

![Figure 2. ‘The deadly effects of beam trawling’ – an artists impression.](image-url)
5. **What is ‘recoverability’?**

‘Recoverability’ is the ability of a habitat, community or species to return to a viable state which is at least close to that which existed before the development, activity or event. Recovery may be because of regrowth (in the case of damaged species capable of regrowing from remaining tissue), re-colonisation by migration or larval settlement from undamaged populations or re-establishment of viability where, for instance, reproductive organs or propagules have been damaged by the event. Recovery can be partial or complete.

There will be many habitats and species that will be adversely affected, even destroyed, by an activity or event. Such effects ‘matter’ to the continued survival of that feature if it does not have the potential to recover.

Von Nordheim, Anderson & Thissen (1996) have published scales for the assessment of regeneration ability in relation to the Red Lists of biotopes, flora and fauna of the Wadden Sea. These scales are: N regeneration impossible; K regeneration hardly possible (>150 years necessary); S regeneration difficult (15-150 years); B regeneration conditionally possible <15 years); X classification not meaningful. The scales being developed for work being undertaken in the MarLIN programme are based on outcomes of the OSPAR IMPACT workshop in February 1997 (OSPAR 1997).

6. **What is ‘importance’?**

Habitats, communities and species are likely to be considered ‘important’ from a nature conservation point-of-view, if they are:

- Rare or very restricted in their distribution. For instance, the detached form of knotted wrack *Ascophyllum nodosum mackii* is an ecad (a growth form brought about by local environmental conditions) found in a few sheltered sea loch locations in western Scotland and Northern Ireland. *Leptopsammia pruvoti* is a cup coral known from only five locations in Great Britain. Clumps (small reefs) of the tube worm *Serpula vermicularis* are known only from Loch Creran in Scotland in Great Britain. Lagoon habitats are rare (although they can be locally common) and often hold species not present in marine inlets or on the open coast.

- In decline or have been. For instance, the fan mussel (*Atrina fragilis*), a nationally scarce species (as defined by Sanderson 1996) was once known from several marine inlets in south-west England but has only been found recently in the Helford River.

- A high proportion of the regional or world population or extent. For instance, Great Britain holds about 40% of the world population of Atlantic grey seals (*Halichoerus grypus*) and England has a high proportion of the European chalk coastline.

- Keystone in a biotope species by providing a habitat for other species (especially those which have been subject to decline over recent years). For instance, the horse mussel (*Modiolus modiolus*) attracts a wide range of epifaunal and cryptic species and horse mussel beds are a ‘nursery’ for young scallops. Beds have declined in extent in some areas where mobile bottom fishing gear has been used. The deep water coral *Lophelia pertusa* provides substantial reefs of hard substratum at the edge of the continental shelf where substrata are otherwise mainly sedimentary. *Lophelia* reefs are being damaged by deep-water demersal fishing gear.

- Biotopes with a particularly high species richness. Biotopes may have a particularly high species richness when they provide both sedimentary and hard substrata: for instance, well-developed beds of maerl (*Phymatolithon calcareaum* and *Lithothamnium corallioides*); or when they provide shelter for a particular community (for instance amongst beds of sea grass *Zostera marina*). Some biotopes are rich for less certain reasons but which might be
associated with stable environmental conditions that allows colonisation by a large number of species.

- Particularly good or extensive representatives of their type (habitats or communities). For instance, the well developed and extensive areas (as length of coastline) of the sealoch biotope characterised by the brachiopod *Neocrania anomala* and the sea anemone *Protanthea simplex* present in Loch Duich, Scotland.

Progress has also been made in adapting criteria developed by terrestrial conservationists to marine ecosystems. The development of criteria to identify species that are rare or scarce has been undertaken by Sanderson (1996). For action in the UK under the Biodiversity Convention, criteria have recently been developed to identify marine habitats and species for biodiversity action plans (Box 5).

Identification of species for action plans is especially weighted towards those that are vulnerable because of their low fecundity, high age of first maturity and/or inability to re-colonise an area after loss or removal (due to their particular developmental biology).

Where there are sensitive features in an area, especially if they have low recovery potential, human activities that damage those features matter most if the features are ‘important’. A ‘decision tree’ that illustrates how importance is addressed is shown in Figure 4. Whilst ‘importance’ might relate to commercial interests, recreation or other uses of the marine environment, the importance for the maintenance of biodiversity alone is considered in the approach shown in Figure 4.

There are well-developed criteria for the assessment of importance, aimed mainly at identifying potential marine protected areas (Hiscock 1997). The ‘importance’ of a site for nature conservation, for the past forty years or so, been based on the use criteria such as ‘representativeness’, ‘rarity’ and ‘diversity’ (see Hiscock

### Box 5.

**Selection criteria being used in the UK to identify habitats and species for Biodiversity Action Plans to be prepared to fulfil obligations under the Biodiversity Convention.**

**Habitats**
- Habitats for which the UK has international obligations.
- Habitats at risk, such as those with a high rate of decline especially over the past 20 years.
- Habitats which are rare.
- Areas, particularly marine areas, which may be functionally critical for organisms inhabiting wider ecosystems.
- Marine habitats if 40% or more of the north-east Atlantic’s occurrence of the habitat is located in the UK.
- Habitats which may be formed from a keystone species – one which hosts a characteristic community of other species.
- Areas important for rare species.

**Species**
- Threatened endemic and globally threatened species.
- Species where the UK has more than 25% of the world or appropriate biogeographical population.
- Species where number or range have declined by more than 25% in the last 25 years.
- Species found in fewer than 15 10x10 km squares in the UK.
- Species for which the UK has international obligations or which are protected under UK legislation.
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Nature of development, activity or event

Resulting environmental perturbation(s)

Seabed wildlife sensitivity information from MarLIN
Are habitats, communities or species likely to be damaged by the environmental perturbations being considered?

Yes, slightly

Yes, moderately severely

Yes, severely

Recoverability information from MarLIN
Will re-growth, re-colonisation or re-establishment of viability occur?

Yes, rapidly and fully

No or slowly or incompletely

Is the habitat, community or species ‘important’? Information from MarLIN or other sources

No

Yes

Action not required

Surveillance appropriate

Action required to minimise impact

Strong action required to prevent impact occurring

Action may not, of course, be possible

Figure 4. A ‘decision tree’ for environmental management incorporating concepts of sensitivity and importance (summarised from Hiscock 1999).
Application of such criteria has resulted in the identification of protected areas but can also be used to identify the marine natural heritage importance of any location where there is sufficient information available.

Having 'contextual' information is very important to assessment of importance and there is now a very large resource of information available in Britain and Ireland mainly as a result of the work of the UK nature conservation agencies and, in Ireland, the results of the BioMar programme. Much more data exists and, with rapid access through networks, it will be possible to make much more effective use of that information. This is the ‘Seabed data acquisition’ Sub-programme within MarLIN.

In Britain, the nature conservation agencies, through their Marine Nature Conservation Review (MNCR) programme, have developed a protocol for site assessment based on seabed features. Each assessment is undertaken within physiographically and/or biogeographically distinct parts of the coast – there are 15 for Great Britain – or physiographically similar features; for instance, the Scottish fjordic sea lochs. Assessments are undertaken between defined areas using biotopes or biotope complexes (Connor et al. 1997 a&b) as the final comparative units. The MNCR is thus identifying specific locations (rather than certain biotopes) as of marine natural heritage importance so that their conclusions are not directly useful to this project but are of great significance for environmental sensitivity mapping.

The criteria used by Von Nordheim, Anderson & Thissen (1996) to define ‘threat categories’ for biotopes in the Wadden Sea area have been taken account of. These use the sort of information resources which we have for marine biotopes and species. Similarly, the criteria being developed in the UK to identify marine habitats (including biological habitats) and species for Biodiversity Action Plans, in order to fulfil obligations under the Biodiversity Convention, provide criteria to assess ‘importance’. Selection criteria being used in the UK have been adjusted to take account of information resources for marine habitats and species. In particular, criteria for marine species are applied for species which are wide ranging and cannot be protected within a designated area and which are vulnerable because of their low fecundity, high age of first maturity and/or inability to re-colonise an area after loss or removal (due to particular developmental biology). The selection criteria, which are for terrestrial and marine features are given in the Box 5.

If a species or biotope is ‘rare’ or ‘scarce’, it immediately identifies itself as worthy of protection and ‘rarity’ is an internationally recognised and used criterion. Interpreting IUCN guidelines (IUCN 1994) in a Great Britain context, nationally ‘rare’ and ‘scarce’ species have been identified on the basis of their percentage occurrence in 10x10 km map squares. For inshore areas within the three nautical mile (c.5.5km) limit of territorial seas (which approximates to the zone under the influence of coastal processes), a ‘nationally rare’ species would occur in 8 or fewer squares, and a ‘nationally scarce’ species in 9 to 55 squares (Sanderson, 1996). There are significant problems in identifying ‘rarity’ especially in relation to availability of data but the value of this criterion demands pragmatic approaches. Applying such quantitative measures offshore requires further discussion and the development of international standards.

7. The Database

7.1. Development of the database

In order to store and interrogate the large amounts of data that are to be included within MarLIN’s activities it is necessary to utilise database software. Databases provide an excellent storage and retrieval system for the type of information being developed by MarLIN and allow the user to formulate ‘queries’ to extract the exact information they require from the system.
A scoping study was carried out to identify the software requirements of the programme, the available database software and approaches to develop a user-friendly interface (Lear 1999). Lear (1999) identified the following criteria. The software must:

- be ‘relational’ in its structure (i.e. links between fields, dynamically updateable data);
- be accessible through the Internet;
- permit data entry and manipulation through the Internet;
- allow complex query formation, based on existing data;
- be compatible with other data systems currently in development, such as those within JNCC and the countryside agencies;
- provide sufficient security for data held within it;
- allow data to be readily imported and exported from it;
- be flexible in its design and
- have sufficient capacity for all the data that will be accumulated.

Based on these criteria, Microsoft Access was chosen as the database to provide the backbone of the system. It is widely used within the scientific community and in Web development, and satisfies all the criteria specified above. In addition, it is extensively programmable which allows greater customisation and tailoring of the package to the exact needs of the sub-programme.

The construction of the species database is complete and has undergone rigorous testing. The development of the biotope database is well under way but cannot be completed until the data entry fields are finalised.

The scoping study (Lear1999) also concluded that:

- a Web interface would be used to disseminate and receive information;
- online glossaries would provide clarification of terms for non-specialist users;
- the user interface would utilise Active Server Pages (ASP) and Common Gateway Interface (CGI) technology.

### 7.2. Key information fields

#### 7.2.1 Introduction

The ‘key information’ fields expected to be researched and summarised were initially discussed at the Newcastle species recording workshop in February 1998 (Foster-Smith 1998). They have since been used to produce key information reviews as a background to Species Action Plans (UK Biodiversity Action Plans) (an example is given as Appendix 5) and for the OSPAR IMPACT meeting in September 1998 (an example is given as Appendix 6). Some of the trialling and calibration of effort required had therefore already been carried out when project staff came into post.

Significant changes were made to the species key information fields following meetings of the Biology and Sensitivity Key Information Management Group of MarLIN in November 1998 and March 1999 and following a sensitivity workshop held in Bangor in January 1999. From extensive testing and experience of actual data entry, further slight modifications have been made in September 1999. The biotope key information fields are still in a draft form and have undergone considerable modification during October 1999.
Key information is entered to a Microsoft Access database which has a wide range of facilities for accessing scales and presenting information. The procedure for data entry is detailed in *MarLIN* Report No. 4 - Assessing seabed species and ecosystem sensitivities. Rationale and user guide (Tyler-Walters and Jackson 1999).

### 7.2.2 Species fields

With the species key information fields finalised and testing of the database complete no further changes to the database structure are anticipated. Data entry commenced in April 1999. At present, basic information has been entered for ninety species and completed for twenty-two species. An example of a data entry form used to populate the species database is shown in Figure 5. A complete list of the species key information fields is given in Appendix 7.

![Figure 5](image-url)  
**Figure 5.** Data entry fields for the adult general biology of a species.

### 7.2.3 Habitat/biotope fields

The draft version of the key information fields for the biotope database has undergone considerable modification and is in the process of being finalised. An example of a data entry form that is used to populate the biotope database is shown in Figure 6. The draft key information fields for habitat / biotope biology and sensitivity assessment are given in Appendix 7.

### 7.2.4 Data entry.

Searching for the key information will rely to some extent on straightforward library and Internet searches but will be greatly aided by advice from relevant experts as to sources of academic data.
Completion of some fields in the database will be obligatory in order for basic information to be produced. This basic information can be entered relatively quickly. The remaining fields are prioritised for data entry. Those fields required to add value to biological information (sensitivity, recoverability and importance) along with others of general interest will be targeted first.

Some fields can be completed automatically from electronic resources already in existence. For example the electronic biotope classification (JNCC) and species dictionary (Ulster Museum/Marine Conservation Society) will be used to fill in appropriate fields.

It will be possible to include images of species, biotopes, geographical distribution and even relationships or life cycles etc. However, the key information will not include identification keys or guides.

Quality assurance will be essential and it is proposed that relevant experts referee completed key information reviews. The species and biotope reviews will be published on the Internet so that feedback can be obtained from anyone who looks at them.
8. Sensitivity and recoverability assessments

8.1 Species and biotope sensitivity assessments

Numerous studies have considered the assessment of sensitivity in recent years. The most important or useful are reviewed in Appendix 4. The ICES Benthos Working Group workshops, held under the auspices of the OSPAR IMPACT group, studies commissioned or undertaken by the nature conservation agencies in the UK and subsequent development by MarLIN have all contributed to the scales shown in Tables 1 & 2.

Table 1. Species sensitivity scale developed for MarLIN and used after September 1999.

<table>
<thead>
<tr>
<th>SPECIES SENSITIVITY</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>The species population is likely to be killed/destroyed by the factor under consideration.</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Some individuals of a species population may be killed/destroyed by the factor under consideration and the viability of a species population will be reduced.</td>
</tr>
<tr>
<td>Low</td>
<td>A species population is unlikely to be killed/destroyed by the factor under consideration. However, the viability of a species population will be reduced.</td>
</tr>
<tr>
<td>Not sensitive</td>
<td>The factor does not have a detectable effect on survival or viability of a species population.</td>
</tr>
<tr>
<td>Not sensitive*</td>
<td>A species population may increase in abundance or biomass as a result of the factor.</td>
</tr>
<tr>
<td>Not relevant</td>
<td>This rating applies to species populations where the factor is not relevant because they are protected from the factor (for instance, through a burrowing habit), or can move away from the factor.</td>
</tr>
</tbody>
</table>

The present sensitivity scales take into account the need to separate sensitivity sensu stricto from frequency of occurrence, intensity and duration of the factor which are elements of vulnerability. The scale also incorporates sub-lethal damage and reproductive effects.

8.2. Benchmarks for sensitivity assessment

In order to be able to make valid comparisons between species, sensitivity to each factor needs to be assessed against a single fixed value or benchmark. Benchmarks are listed in MarLIN Report No. 4 (Tyler-Walters & Jackson 1999).
8.3. Species and biotope recoverability assessment

The scale developed by MarLIN for recoverability potential is given in Table 3. The same scale has been applied to both species and biotopes.

Table 2. Biotope sensitivity scale developed for MarLIN and used after September 1999.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Definition (adapted from Hiscock, Jackson &amp; Lear 1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Keystone/dominant species in the biotope or habitat are likely to be killed/destroyed by the factor under consideration.</td>
</tr>
<tr>
<td>Intermediate</td>
<td>The population(s) of keystone/dominant species in a community may be reduced/degraded by the factor under consideration, the habitat may be partially destroyed or the viability of a species population, diversity and function of a community may be reduced.</td>
</tr>
<tr>
<td>Low</td>
<td>Keystone/dominant species in a community or the habitat being considered are unlikely to be killed/destroyed by the factor under consideration and the habitat is unlikely to be damaged. However, the viability of a species population or diversity / functionality in a community will be reduced.</td>
</tr>
<tr>
<td>Not sensitive</td>
<td>The factor does not have a detectable effect on structure and functioning of a biotope or the survival or viability of keystone/important species</td>
</tr>
<tr>
<td>Not sensitive*</td>
<td>The extent or species richness of a biotope may be increased or enhanced by the factor.</td>
</tr>
<tr>
<td>Not relevant</td>
<td>Sensitivity may be assessed as not relevant where communities and species are protected or physically removed from the factor (for instance circalittoral communities are unlikely to be effected by increased emergence regime).</td>
</tr>
</tbody>
</table>

8.4. Confidence

In line with the requirements for Quality Assessment of the information provided by the MarLIN Biology and Sensitivity Key Information Sub-programme, confidence levels are allocated to each assessment. Definitions for the various levels of confidence used by MarLIN are shown in Table 4.

9. Publication of information

Information from the database will be published on the Internet in the form of standardised web pages. Specific products, on CD or paper may be produced from time-to-time.

The data fields will be available through a Web interface, facilitating the distribution of the information through the Internet. This will be achieved by a combination of Active Server Pages (ASP) and custom made Visual Basic applications. This combined approach will give greater
flexibility to the system. Technical details of the Web interface under development are given in the software scoping study (*MarLIN* Report No. 2; Lear 1999).

Table 3. Recoverability potential.

<table>
<thead>
<tr>
<th>RECOVERABILITY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Recovery is not possible.</td>
</tr>
<tr>
<td>Very low</td>
<td>Partial recovery is only likely to occur after about ten years and full recovery may take over 25 years.</td>
</tr>
<tr>
<td>Low</td>
<td>Only partial recovery is likely within ten years and full recovery is likely to take up to 25 years.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Only partial recovery is likely within five years and full recovery is likely to take up to ten years.</td>
</tr>
<tr>
<td>High</td>
<td>Full recovery will occur but will take many months (or more likely years) but should be complete within about five years.</td>
</tr>
<tr>
<td>Very high</td>
<td>Full recovery is likely within a few weeks or at most six months.</td>
</tr>
<tr>
<td>Immediate</td>
<td>Recovery immediate or within a few days</td>
</tr>
</tbody>
</table>

Table 4. Confidence levels for sensitivity and recoverability assessments.

<table>
<thead>
<tr>
<th>CONFIDENCE</th>
<th>A feeling of reliance or certainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence level</td>
<td>Definition</td>
</tr>
<tr>
<td>High</td>
<td>Assessment has been derived from sources that specifically deal with sensitivity and recoverability to a particular factor. Experimental work has been done investigating the effects of such a factor.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Assessment has been derived from sources that consider the likely effects of a particular factor.</td>
</tr>
<tr>
<td>Low</td>
<td>Assessment has been derived from sources that only cover aspects of the biology of the species or from a general understanding of the species. No information is present regarding the effects of factors.</td>
</tr>
<tr>
<td>Very low</td>
<td>Assessment derived by ‘informed judgement’ where very little information is present at all on the species.</td>
</tr>
<tr>
<td>Not relevant</td>
<td>The available information does not support an assessment, the data is deficient or no relevant information has been found.</td>
</tr>
</tbody>
</table>

It is important that the presentation of the information as a ‘front end’ is as user-friendly as possible. The information is targeted at a wide audience, including school children, amateur data recorders and professional researchers. The proposed layout of information from the species and biotopes sections of the database is shown in Figures 7 and 8.
In addition to the information provided in the species and biotope pages, it will be possible to interrogate of the database directly. This will be able to be done in two ways:

- the selection of ‘generic’ frequently asked questions, for example “list all of the species in the database covered by Biodiversity Action Plans”; and
- creation of user-defined queries “on the fly”, for example “list all of the species in the database that are highly sensitive to changes in oxygenation.

This ‘layered’ approach will ensure that the user can to select the information they require at the level of detail they require.

10. Acknowledgements

Much of the text in this report has been copied from reports and publications produced on the topic of sensitivity by Keith Hiscock. Harvey Tyler-Walters has contributed significantly to the October version.
Figure 7. How various information pages for a species currently appear after interrogation of the database.
Figure 8. How various information pages for a biotope currently appear after interrogation of the database.
11. References


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Critchley, A.T., 1983b. The establishment and increase of *Sargassum muticum* populations within the Solent area of southern Britain. I. An investigation of the increase in canopy cover of the algae at low water. *Botanica Marina*, 26, 547-552.


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Appendices

Appendix 1. MarLIN Objectives and Guiding Principles

**MarLIN OBJECTIVES AND GUIDING PRINCIPLES**

THE BIOLOGY AND SENSITIVITY KEY INFORMATION SUB-PROGRAMME

**Objective 1**

To provide the scientific information required by marine and coastal managers to better understand and describe the sensitivity of key seabed habitats, biotopes and species to natural events and human activities.

**Guiding principles to Objective 1**

1. The habitats, biotopes and species will be those which are commonly accepted: biotope complexes, biotopes and sub-biotopes from the MNCR biotopes classification (as amended) (Connor *et al.* 1997); species from the MCS/Ulster Museum Species Directory (Howson & Picton 1997) (supplemented for deep water areas within the EEZ.)

2. Any scale developed within MarLIN to indicate sensitivity of a habitat biotope or species must:
   1. take account of systems already developed to use their best features;
   2. be assessed against scales developed as a result of expert workshops;
   3. be assigned a confidence rating which also indicates ‘lack of knowledge’;
   4. be disseminated in a form capable of understanding by non-biologists.

3. Acknowledging that preparing full key information and sensitivity assessments for a habitat, biotope or species is a time consuming activity, to adopt an overall two-tiered approach to the development and implementation of the sensitivity work as follows:
   1. Initially, selective information will be entered to the database for all priority habitats, biotopes and species according to the criteria listed below.
   2. Subsequently, further information will be entered for high priority habitats, biotopes or species.

**Priority will be given to habitats, biotopes and species that:**

a. the UK Government has management responsibilities or obligations for under international conventions and directives including protected species and BAP listed species;

b. have been identified in European workshops as threatened or requiring documentation;

c. are subject to national regulations;

d. contribute to national nature conservation initiatives;

e. are surrogates for the condition of other habitats, biotopes or species;

f. are indicators of threatening processes;

g. are at high risk of impact due to their sensitivity or vulnerability;

h. are nationally rare or scarce;

i. are ‘keystone’ or characteristic species of a habitat or biotope.
4. Some habitats, biotopes and taxonomic groups that are well documented will also be researched/entered to the database to trial the development of the information fields and database.

5. As habitat, biotope and species pages are completed, they will be refereed by collaborators with experience in the relevant field.

6. Habitat, biotope and species pages will be available on the web and comments will be invited especially on the completed key information and to identify further information sources.

Objective 2

To develop a user-friendly computer-based system that will allow the information thus gathered to be interpreted and used by decision-makers applying the ecosystem approach to environmental management.

Guiding principles to objective 2

1. Demonstration material will be openly accessible on the Internet.

2. Full information will be available through the Internet and CD-ROMs or an Intranet as appropriate to partners / subscribers to MarLIN.

3. The system will operate by linking to geo-referenced data sources including MNCR data, accessed under the MarLIN seabed data access and acquisition sub-programme.

4. The information will be presented in a format and in a level of detail that will enable organisations or individuals with an interest or responsibility in the marine environment to undertake a preliminary assessment of the likely impact of a human activity or operation on marine habitats, biotopes or species.

5. The information will be accessed using a variety of approaches, including:
   - from an accepted list of potential threatening activities;
   - from the component factors of an activity;
   - from the species or biotope dictionaries.

Threatening activities will be modified from the Marine Conservation Handbook and JNCC Marine Information Team keywords.
Appendix 2. Glossaries

**General**: Glossary of technical marine biological terms likely to be used in the Biology and Sensitivity Key Information Sub-programme. Compiled from McLeod (1996) with additions from Hiscock (1998) and various other references.

**abiotic** Devoid of life.

**aboral** Opposite the end/side on which the mouth is located (Kozloff 1996).

**abundance scale** A scale describing the relative abundance of organisms (as numbers of individuals per unit area or as % cover), with groupings in several broad categories. In the case of the MNCR’s semi-logarithmic ‘SACFOR’ scale, the units are Superabundant; Abundant; Common; Frequent; Occasional; Rare. (Scale from Connor & Hiscock 1996).

**accretion** Build up or accumulation of sediment.

**activity (maritime)** An anthropogenic operation or activity which occurs in the marine or coastal environment (Cooke and McMath 1998).

**aggregation** Organisms (usually referring to of the same species) living closely together, but not physically connected (cf. ‘colony’).

**algal mat** A dense mass of green or other algae (e.g. Enteromorpha spp., Ulva spp.) which blankets the substratum in a littoral or shallow-water environment, often in areas of freshwater influence or where eutrophication occurs.

**alien species** A non-established introduced species (q.v.), which is incapable of establishing self-sustaining or self-propagating populations in the new area without human interference (cf. ‘introduced species’; ‘non-native’).

**anadromous (of fish)** Upward-running: spending part of their life in the sea and migrating up rivers in order to breed (e.g. salmon) (cf. ‘catadromous’).

**anaerobic** An environment in which the partial pressure of oxygen is significantly below normal atmospheric levels; deoxygenated (Lincoln et al.1998).

**annulated** Where the external surface is divided into a chain of rings or ‘annuli’ by furrows giving the appearance of segments (Barnes et al.1993).

**anoxic** Devoid of oxygen.

**anthropogenic** Produced by human activity.

**aquaculture** The cultivation of aquatic organisms by human effort for commercial purposes. For the cultivation of marine organisms in seawater, the term ‘mariculture’ is also used. (Based on Baretta-Bekker et al.1992.)

**arborescent / arbuscular** Having the shape or characteristics of a tree.

**arctic** Referring to a biogeographical region centred north of the British Isles and influencing the extreme north of the British Isles.

**articulate** Jointed, arthrous (Holmes 1979).

**assessment** 1) The evaluation of marine natural heritage importance through an orderly process of gathering information about biotopes and species in an area and comparing their attributes by a standard protocol (as in ‘conservation assessment’). 2) The evaluation of the likely impact of a development on the environment (as in ‘Environmental Impact Assessment’).

**association** A term used by botanists to refer to an assemblage of plants with a definite floristic composition, considered by many workers to be synonymous or very similar to the zoological concept of ‘community’ (from Hiscock & Connor 1991).

**attribute** A characteristic of a habitat, biotope, community or population of a species which most economically provides an indication of the condition of the interest feature to which it applies. (CSMR.)

**autecology** The ecology of individual organisms or species (Lincoln et al.1998) (cf. ‘syneiology’).

**autotrophic** Self-feeding, producing organic matter through photosynthesis (Prescott 1969).

**azoic** Devoid of animal life.
bathyal  Pertaining to the sea floor between 200 m and 4000 m (Lincoln & Boxshall 1987).
between 200 m and 4000 m (Lincoln & Boxshall 1987).
bivalved Characteristically a shell of two calcareous valves joined by a flexible ligament.
boreal 1) biogeographical Pertaining to cool or cold temperate regions of the northern hemisphere (Lincoln et al.1998). 2) Marine zoogeography Ekman (1953) states that the centre of the boreal region lies in the North Sea. It is bounded by the subarctic transitional zone to the north between Shetland, the Faroe Islands and Iceland and in the south-west of Britain by a transitional zone with the Mediterranean-Atlantic lusitanian region.
boring Makes an excavation (through physical or chemical action) in which to live.
brackish Referring to mixtures of fresh and seawater. Usually regarded as between 0.5 ‰ and 30 ‰ salinity (q.v.) (based on McLusky 1993).
budding A form of asexual multiplication in which a new individual begins life as an outgrowth from the body of the parent. It may then separate to lead an independent existence or remain connected or otherwise associated to form a colonial organism (Barnes et al.1993).
bullate (saccate) Balloon or sac-like (Prescott 1969).
calcareous Containing calcium carbonate; chalky. (Of organisms): a species which accumulates calcium carbonate in its tissues.
capitate Enlarged or swollen at the apex, with a ‘head’, clubbed. (Prescott 1969).
carnivore A predator which feeds on animals.
**MarLIN**: Assessing seabed species and ecosystems sensitivities.  
Existing approaches and development

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catatadromous (of fish)  Downward-running: spending most of their life in rivers and migrating downstream to the sea in order to breed (e.g. eels) (cf. ‘anadromous’).

**characteristic** (species)  Special to or especially abundant in a particular situation or biotope.  
Characteristic species should be immediately conspicuous and easily identified. (Based on Hiscock & Connor 1991.)

circalittoral  The subzone of the rocky sublittoral below that dominated by algae (the infralittoral), and dominated by animals. No lower limit is defined, but species composition changes below about 40m to 80m depth, depending on depth of the seasonal thermocline. This subzone can be subdivided into the upper circalittoral where foliose algae are present and the lower circalittoral where they are not (see Hiscock 1985). The term is also used by Glémarec (1973) to refer to two étages of the sediment benthos below the infralittoral: a "coastal circalittoral category with a eurythermal environment of weak seasonal amplitude (less than 10°C) varying slowly" and a "circalittoral category of the open sea with a stenothermal environment".  
1) lower The part of the circalittoral subzone on hard substrata below the maximum depth limit of foliose algae (based on Hiscock 1985).  
2) upper The part of the circalittoral subzone on hard substrata distinguished by the presence of scattered foliose algae amongst the dominating animals; its lower limit is the maximum limit of depth for foliose algae (based on Hiscock 1985).

classification  
1) taxonomy  The placing of animals and plants in a series of increasingly specialised groups because of similarities in structure, origins etc., that indicate a common relationship (from Makins 1991).  
2) biotopes  The process of identifying distinctive and recurrent groupings of species with their associated habitat and describing them within a structured framework.

clathrate  Latticed (Holmes 1979).

clonal  An assemblage of organisms derived by asexual or vegetative multiplication from a single original parent – generally assumed to be genetically identical. (From Lincoln *et al*. 1998.)

coastal zone  The space in which terrestrial environments influence marine (or lacustrine) environments and *vice versa*. The coastal zone is of variable width and may also change in time. Delimitation of zonal boundaries is not normally possible; more often such limits are marked by an environmental gradient or transition. At any one locality the coastal zone may be characterised according to physical, biological or cultural criteria, which need not, and rarely do, coincide. (Based on Carter 1988.)

colonial  Descriptive of organisms produced asexually which remain associated with each other; in many animals, retaining tissue contact with other polyps or zooids as a result of incomplete budding (Barnes *et al*. 1996).

colonisation  The process of establishing populations of one or more species in an area or environment where the species involved were not present before (from Baretta-Bekker *et al*. 1992).

colony  
1) A group of organisms of the same species living connected together in a common mass (Fitter & Manuel 1986.) (cf. ‘aggregation’).  
2) A group of organisms connected by behavioural or sociological factors (e.g. seabird colony, seal colony).

commensalism  Symbiosis (q.v.) in which one species derives benefit from a common food supply, whilst the other species is not adversely affected (Lincoln *et al*. 1998).

community  A group of organisms occurring in a particular environment, presumably interacting with each other and with the environment, and identifiable by means of ecological survey from other groups (from Mills 1969; see Hiscock & Connor 1991 for discussion.)

certainty  A feeling of reliance or certainty (Thompson 1995).

conservation (nature)  "The regulation of human use of the global ecosystem to sustain its diversity of content indefinitely" (Nature Conservancy Council 1984).
constancy  1) The frequency of occurrence of a species in samples from the same community (based on Makins 1991).  2) The continued presence of a species or community at a particular location. (Cf. ‘persistence’, ‘resilience’, ‘stability’).

contamination “An increase of background concentration of a chemical or radionuclide” (from Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection - GESAMP - 1995).

coralline Relating to, or resembling, coral, especially any calcareous red alga impregnated with calcium carbonate.

cosmopolitan Of worldwide distribution (Brusca 1980).

critically endangered (IUCN Red List categories) A taxon is Critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future (International Union for the Conservation of Nature and Natural Resources 1994) (cf. ‘Extinct’, ‘Endangered’, ‘Vulnerable’).

crustose Forming or resembling a crust (Thompson 1995).

cryptic (cryptozoic) 1) An animal which lives in hidden places, such as crevices, caves or beneath stones.  2) An organism whose appearance or coloration makes it difficult to see or recognise.

cylindrical With straight sides and a circular section (Thompson 1995).

decomposers Organisms which feed by breaking down dead organic matter (from Lincoln et al.1998).

demersal Living at or near the bottom of a sea or lake, but having the capacity for active swimming (from Lincoln et al.1998).

dendroid Branching irregularly – similar to that of a root system (Prescott 1969).

dependency (conservation assessment) The reliance (of a species, community or ecological process) on a particular location (for instance, a feeding, breeding, sheltering area or a migration corridor) or structure (for instance, a kelp forest, a sea grass bed, a maerl bed) for survival.

deposit-feeders Any organisms which feed on fragmented particulate organic matter in or on the substratum; detritivores (from Lincoln et al.1998).

desiccation Removal of water; the process of drying. (Lincoln et al.1998)

detritus Fragmented particulate organic matter, derived from the decomposition of plant and animal remains.

diel Daily, pertaining to a 24 hour period (Lincoln et al.1998).

digitate Having parts arranged like fingers on a hand (Holmes 1979).

dimorphic Occurring in two distinct forms (usually morphological forms) (Barnes et al.1993).

direct development Development without a larval stage (cf. indirect development)(Barnes et al.1993).

disturbance “A chemical or physical process caused by humans that may or may not lead to a response in a biological system within an organism or at the level of whole organisms or assemblages. Disturbance includes stresses”. (from Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection - GESAMP - 1995).

diversity The state or quality of being different or varied (from Makins 1991). In relation to species, the degree to which the total number of individual organisms in a given ecosystem, area, community or trophic level is divided evenly over different species, i.e. measure of heterogeneity. Species diversity can be expressed by diversity indices, most of which take account of both the number of species and number of individuals per species (Based on Baretta-Bekker et al. 1992). Cf. ‘evenness’; ‘richness’.

diversity (conservation assessment) An assessment of the richness of different types in a location (which can be large or small) including the number of different biotopes and numbers of species. The number of species present in an example of a particular biotope.
ecad  A plant or animal form produced in response to particular habitat factors, the characteristic adaptations not being heritable; a habitat form (from Lincoln et al. 1998).

ecology  The study of the inter-relationships between living organisms and their environment (from Lincoln et al. 1998).

Ecological Quality (EcoQ)  An expression of the structure and function of the ecological system taking into account natural physiographic, geographic and climatic factors as well as biological, physical and chemical conditions including those resulting from human activities (from a draft of the EC Ecological Quality of Water Directive).

Ecological Quality Objective (EcoQO)  The desired level of the EcoQ relative to a reference level.

esystem  A community of organisms and their physical environment interacting as an ecological unit (from Lincoln et al. 1998). Usage can include reference to large units such as the North Sea down to much smaller units such as kelp holdfasts as "an ecosystem".

ecotone  The zone of transition between two major ecological communities.

endangered (IUCN Red List categories)  A taxon is considered Endangered when it is not Critically endangered (q.v.) but is facing a very high risk of extinction in the wild in the near future (International Union for the Conservation of Nature and Natural Resources 1994) (cf. ‘Extinct’, ‘Critically endangered’, ‘Vulnerable’).

endemic  Referring to organisms that are confined to a particular area or geographical location (Prescott 1969).

environment  The complex of biotic climatic, edaphic and other conditions which comprise the immediate habitat of an organism; the physical, chemical and biological surroundings of an organism at any given time. (cf. ‘habitat’)(from Lincoln et al. 1998).

Environmental Assessment (EA)  Environmental Impact Assessment (EIA)  A process of predicting and evaluating an action’s impacts on the environment, from which the conclusions are used as a tool in decision-making. It aims to minimise environmental degradation by giving decision-makers better information about the consequences which development actions could have on the environment, although it cannot, in itself, achieve that protection (based on Pritchard 1993). An Environmental Assessment can be used to produce an Environmental Statement (ES). Cf. ‘Environmental Statement’ ‘Strategic Environmental Assessment’

Environmental Statement (ES)  A statement intended to provide all of the information needed to evaluate the likely environmental implications of a proposed development. (Adapted from Treweek 1996). Cf. ‘Environmental Assessment (EA)’.

epibenthos  All organisms living on the surface of the seabed.

epifauna  Animals living on the surface of the seabed.

epilithic  Growing on the surface of rock.

epiphytic  Growing on the surface of a living plant (but not parasitic upon it).

epizoic  Growing or living on the exterior of a living animal (but not parasitic upon it).

euhaline  Fully saline seawater > 30 ‰ salinity.

eulittoral  The main part of the littoral zone characterised by limpets, barnacles, mussels, fucoid algae (other than those characteristic of the littoral fringe), with red algae often abundant on the lower part. It lies above the main population of Laminariales. Zonation within the eulittoral is variable, with two to four (commonly three) belts often clearly discernible. 1) (lower) The lower belt of the eulittoral subzone, bordering the sublittoral fringe, and generally dominated by Fucus serratus and red algae. 2) (mid) The broad middle belt of the eulittoral subzone, usually characterised by limpets and barnacles or Mytilus and filamentous red algae in exposed situations, or dominated by fucoids, often with clumps of large mussels present, in shelter. 3) (upper) The narrow upper belt of the eulittoral subzone, often very variable in character. (from Hiscock 1990).
**euryhaline** Of or relating to the capability of an organism to live in environments of variable salinity (from Charton & Tietjen 1989).

**eurythermal** Of or relating to the capacity of some organisms to survive in a wide range of temperatures (from Charton & Tietjen 1989).

**eutrophication** The over-enrichment of an aquatic environment with inorganic nutrients, especially nitrates and phosphates, often anthropogenic (e.g. sewage, fertiliser run-off), which may result in stimulation of growth of algae and bacteria, and can reduce the oxygen content of the water.

**exposed (wave exposure)** 1) Coasts which face the prevailing wind but which have a degree of shelter because of extensive shallow areas offshore, offshore obstructions, or a restricted (less than 90°) window to open water. These sites are not generally exposed to large waves or regular swell. 2) Open coasts facing away from prevailing winds but with a long fetch, and where strong winds are frequent (from Hiscock 1990).

**exposure** The degree of wave action on an open shore, governed by the distance of open sea over which the wind may blow to generate waves (the fetch) and the strength and incidence of the winds (Hawkins & Jones 1992). Expressed as a descriptive scale for MNCR recording. Cf. ‘exposed’, ‘extremely exposed’, ‘sheltered’, ‘ultra-sheltered’, ‘very exposed’, ‘very sheltered’.

**extent (conservation assessment)** In identifying sites for protection, preference will be given to sites with larger examples of highly rated or rarer biotopes. It is also necessary to consider the size of site required to ensure that the unit to be managed is ‘viable’.

**extinct (IUCN Red List categories)** A taxon is ‘extinct’ when there is no reasonable doubt that the last individual has died (International Union for the Conservation of Nature and Natural Resources 1994). The term can be applied on a local or national basis as well as world-wide and is also used to refer to situations where it no longer exists from a particular point of view (for instance: ‘functionally extinct’; ‘commercially extinct’). Cf. ‘Critically endangered’, ‘Endangered’, ‘Vulnerable’.

**extremely exposed (wave exposure)** Open coastlines which face into the prevailing wind and receive both wind-driven waves and oceanic swell without any offshore obstructions such as islands or shallows for several thousand kilometres and where deep water is close to the shore (50 m depth contour within about 300 m) (from Hiscock 1990).

**extremely sheltered (wave exposure)** Fully enclosed coasts with a fetch of no more than about 3 km (from Hiscock 1990).

**facies (biological)** A geographical variant of a marine community, or a variant which includes a conspicuous or abundant species not present in the main community (based on Hiscock & Connor 1991, from Cotton 1912).

**factor (environmental)** A component of the physical, chemical, ecological or human environment that may be influenced by natural events or anthropogenic activity (Tyler-Walters & Jackson 1999).

**fauna** 1) The animal life of a given region, habitat or geological period; 2) A descriptive catalogue of the above (from Lincoln et al.1998).

**fecundity** The potential reproductive capacity of an organism or population, measured by the number of gametes (eggs) or asexual propagules.

**filiform** Filamentous slender and thread-like (Kozloff 1996).

**filter-feeder** (see ‘suspension-feeder’)

**fission** Form of asexual multiplication involving division of the body into two or more parts each or all of which can grow into new individuals (Barnes et al.1993).

**flabellate** Shaped like a fan, fanlike (Brusca 1980).

**flaccid** Soft, limp, flabby (Brusca 1980).

**flora** 1) The plants or plant life of a particular region, habitat or geological period. 2) A descriptive catalogue of the above. (from Lincoln et al.1998).
foliaceous Bearing leaves or leaf-like structures; having the appearance of a leaf.


funnel shaped In the shape of a funnel.

glbose Spherical / ovoid / globular (Brusca 1980).

gonochoristic Having separate sexes (cf. hermaphroditic) (Barnes et al.1993).

grazers 1) Animals which: rasp benthic algae (or sessile animals, such as bryozoan crusts) from the substratum, or 2) animals which ingest phytoplankton from the water column by suspension-feeding (q.v.).

gregarious Living in groups or communities, growing in clusters.

growth form The physical appearance and structure of an organism (cf. life form).

habitat The place in which a plant or animal lives. It is defined for the marine environment according to geographical location, physiographic features and the physical and chemical environment (including salinity, wave exposure, strength of tidal streams, geology, biological zone, substratum, ‘features’ (e.g. crevices, overhangs, rockpools) and ‘modifiers’ (e.g. sand-scor, wave-surge, substratum mobility). (Cf. ‘environment’).


haline Another term for saline (q.v.).

halocline A horizontal boundary layer in the water-column, at which salinity changes sharply with depth.

heavy metal A generic term for a range of metals with a moderate to high atomic weight, for example cadmium, mercury, lead. Although many are essential for life in trace quantities, in elevated concentrations most are toxic and bioaccumulate, and so are important pollutants.

herbivores Organisms which feed on plants, including phytoplankton.

hermaphroditic Capable of producing both ova and spermatozoa either at the same time (permanent) or sequentially (cf. protandry, protogyne, gonochoristic) (Barnes et al.1993).

holeuryhaline A term used for organisms that freely inhabit fresh water, seawater and brackish water, or which establish populations in all these environments (from Lincoln et al.1998).

holoplankton Plankton with a completely pelagic life cycle (cf. meroplankton) (from Baretta-Bekker et al. 1992).

hydrocarbons Organic compounds containing mainly hydrogen and carbon; the basic constituents of fossil fuels.

importance In the context of marine natural heritage: species or biotopes which are rare or very restricted in their distribution; species or biotopes that are in decline or have been; species or biotopes where a country has a high proportion of the regional or world population or extent; species that are keystone in a biotope by providing a habitat for other species; biotopes with a particularly high species richness; locations or biotopes that are particularly good or extensive representatives of their type. Species will also be ‘important’ if they are listed for protection on statutes, directives and conventions.

imposex An abnormality of the reproductive system in female gastropod molluscs, by which male characteristics are superimposed onto female individuals (Smith 1980), resulting in sterility or, in extreme cases, death. This may be caused by hormonal change in response to pollution from organotin antifoulants, even at low concentrations. See ‘organotin’.
indicator organisms or species  An organism whose characteristics (e.g. presence or absence, population density, dispersion, reproductive success) are used as an index of attributes too difficult, inconvenient, or expensive to measure for other species, or environmental conditions of interest (Landres, Verner & Thomas 1988). Such characteristics may be used to indicate the degree of pollution or other environmental conditions at a particular locality. See Rowell (1994) and GESAMP (1995) for a discussion.

infauna  Benthic animals which live within the seabed.

infralittoral  A subzone of the sublittoral in which upward-facing rocks are dominated by erect algae, typically kelps; it can be further subdivided into the upper and lower infralittoral (based on Hiscock 1985). The term is also used by Glémarec (1973) to refer to areas (étages) with a eurythermal environment of great seasonal and also daily and tidal amplitude. 1) lower The part of the infralittoral subzone which, on hard substrata, supports scattered kelp plants (a kelp park) or from which kelps are absent altogether and the seabed is dominated by foliose red and brown algae. It may be difficult to distinguish the lower infralittoral where grazing pressure prevents the establishment of foliose algae. 2) upper The part of the infralittoral subzone which, on hard substrata, is dominated by Laminariales forming a dense canopy, or kelp forest (based on Hiscock 1985).

inquilinism  A symbiotic association in which one symbiont lives in close association with another, generally in the tube or burrow or actually within a body chamber of the host (Brusca 1980).

international importance  1) biotopes or areas (conservation assessment) Biotopes or areas which are highly rated in a coastal sector (q.v.) are considered of international importance if they are one of the best examples or only examples present in the north-east Atlantic (North Cape, Norway to Gibraltar). This was, until 1995, defined for communities as being: "Communities which are outstandingly good examples of their type in the north-east Atlantic. Communities recorded at only a very few locations in the north-east Atlantic” (Hiscock & Mitchell 1989). Cf. ‘international importance: species’, ‘local importance’, ‘national importance’, ‘regional importance’ (biotopes or areas and species). 2) species (conservation assessment) Species which are recorded at only a very few locations in the north-eastern Atlantic. Species recorded in higher abundance in the area under consideration than anywhere else in the north-eastern Atlantic, or where the area is one of only a few locations where large quantities are recorded (Davies et al. 1990, based on Hiscock & Mitchell 1989). Cf. ‘international importance: biotopes or areas’, ‘local importance’, ‘national importance’, ‘regional importance’ (biotopes or areas and species).

interstitial  Relating to the system of cavities and channels formed by the spaces between grains in a sediment (interstitial space).

intertidal  The zone between the highest and lowest tides (from Lincoln et al. 1998).

introduced species  Any species which has been introduced directly or indirectly by human agency (deliberate or otherwise), to an area where it has not occurred in historical times and which is separate from and lies outside the area where natural range extension could be expected (i.e. outside its natural geographical range (q.v.)). The term includes non-established introductions (‘aliens’ (q.v.)) and established non-natives (q.v.), but excludes hybrid taxa derived from introductions (‘derivatives’).

irreplaceability (conservation assessment)  Not capable of replacement if destroyed in some way. Applied to habitat features, biotopes and species.

iteroparous  Breeding several times per lifetime (cf. semelparous) (Barnes et al. 1993).
keystone species A species which, through its predatory activities (for instance, grazing by sea urchins) or by mediating competition between prey species (for instance, by eating sea urchins), maintains community composition and structure. Removal of a keystone species leads to rapid, cascading changes in the structure they support (based on Raffaelli & Hawkins 1996). The term is also applied here to species which provide a distinctive habitat (for instance a bed of the horse mussel Modiolus modiolus, or kelp plants Laminaria hyperborea) and whose loss would therefore lead to the disappearance of the associated community.

k-strategy A life strategy optimally geared to living in a stable habitat with a high level of interspecific competition. Parental care is facilitated by low fecundity (small litters of large size offspring), by longevity and size. K-strategists are unlikely to be well adapted to recover from population densities significantly below their equilibrium level and may become extinct if depressed to such low levels. (From Baretta-Bekker et al. 1992). Cf. r-strategy.

lanceolate Lance shaped and usually elongate (Brusca 1980).

larva A juvenile phase differing markedly in morphology and ecology from the adult (Barnes et al. 1993).

lecithotrophic Development at the expense of internal resources (i.e. yolk) provided by the female (cf. planktotrophic) (Barnes et al. 1993).

life form Structural types of organisms or growth forms that dominate or are most conspicuous in certain environmental conditions. (based on Richards, Bunker & Foster-Smith 1995) (cf. growth form).

littoral 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 is marked by the top of the Littorina/Verrucaria belt and the lower limit by the top of the laminarian zone (Lewis 1964). It is divided into separate subzones, particularly marked on hard substrata. Cf. ‘intertidal’.

littoral fringe The upper subzone of the littoral zone, bordering the supralittoral. It is characterised by marine lichens, littoral molluscs and algae tolerant of exposure to air for long periods; its lower boundary is characteristically the upper limit of dense barnacles. This subzone can be further subdivided into the upper and lower littoral fringes. (From Hiscock 1990.)

local importance (conservation assessment) Biotopes or locations which are among the best examples or the only examples within a particular physiographic feature or area of coast but occur widely elsewhere in the coastal sector (q.v.). This was, until 1995, defined as being: "communities or areas which are widespread in similar situations but for which the one mentioned is a good example in the coastal sector under consideration". (Based on Hiscock & Mitchell 1989.) Cf. ‘international importance: species’, ‘national importance’, ‘regional importance’ (biotopes or areas and species).

Lowest Astronomical Tide The lowest tidal level which can be predicted to occur under average meteorological conditions and any combination of astronomical conditions (from Ministry of Defence 1987).

lusitanian (biogeographical) Referring to a biogeographical region centred to the south of the British Isles and influencing the extreme south-west of the British Isles.

macrobenthos The larger organisms of the benthos, exceeding 1 mm in length (from Lincoln & Boxshall 1987); often applied to organisms >0.5mm. Cf. ‘meiobenthos’, ‘microbenthos’.

macrofauna Animals exceeding 1 mm in length (Lincoln & Boxshall 1987) or retained on a 1 mm or 0.5mm sieve; often applied to organisms >0.5mm. Cf. ‘meiofauna’, ‘microfauna’.

macroscopic Large enough to be visible to the naked eye, typically exceeding 1mm in length.

maerl Twig-like unattached (free-living) calcareous red algae, often a mixture of species and including species which form a spiky cover on loose small stones - ‘hedgehog stones’.
mariculture The cultivation, under appropriate environmental conditions, of marine organisms in seawater by human effort for commercial purposes (based on Baretta-Bekker et al. 1992 and Charton & Tietjen 1989). (See also ‘aquaculture’.)

marine protected area "Any area of intertidal or subtidal terrain, including geological and geomorphological features, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment." (IUCN definition, as modified by the Marine Protected Area Group, a working group of Wildlife Link’s Joint Marine Group).

Marine Nature Reserve (MNR) A statutory marine protected area declared in Great Britain by the Nature Conservancy Council and its successor agencies under the Wildlife and Countryside Act 1981 for the purpose of conserving marine flora or fauna or geological or physiographical features in the area and providing opportunities for study and research (from Anon. 1994). Voluntary MNRs are non-statutory protected areas agreed by local sea-users and other interested parties.

massive Bulky (Homes 1979).

Mediterranean (biogeographical) An extension of the Atlantic Ocean between Europe and Africa (Charton & Tietjen 1989) often used to describe a biogeographic region but which, according to Ekman (1953), is not a distinct faunal unit but enters into a greater one which includes the neighbouring parts of the Atlantic.

medusoid / medusiform Disk, bell or umbrella shaped and often gelatinous (Barnes et al. 1993).

meiobenthos Small benthic organisms which pass through a 1 mm mesh sieve, but are retained by a 0.1 mm mesh (from Lincoln & Boxshall 1987). Typically, they inhabit interstitial space in sediments. Cf. ‘macrobenthos’, ‘microbenthos’.

meiofauna Small interstitial animals which pass through a 1 mm mesh sieve but are retained by a 0.1 mm mesh (from Lincoln & Boxshall 1987). Cf. ‘macrofauna’, ‘microfauna’.

meroplankton Temporary plankton consisting of pelagic stages of organisms which also have benthic stages. Mainly the larvae of sedentary organisms. (From Baretta-Bekker et al. 1992). Cf. holoplankton.

mesohaline Pertaining to brackish water between 5 ‰ and 18 ‰ salinity (from McLusky 1993).

metagamic Pertaining to reproductive cycles that alternate between sexual and asexual phases (Lincoln, Boxshall and Clark 1998).

microbenthos Microscopic benthic organisms less than 0.1 mm in length (Lincoln & Boxshall 1987). Cf. ‘macrobenthos’, ‘meiobenthos’.

microfauna Small animals less than 0.1 mm length, not visible to the naked eye (cf. ‘macrofauna’, ‘meiofauna’).

microhabitat A small part of the habitat which has distinct physical conditions, e.g. rock crevice.

microscopic Any organism which cannot be observed without the use of a microscope.

migratory Of organisms that move from one habitat or location to another; typically periodically or seasonally and of relatively long distance (from Lincoln et al. 1998)

mobile Capable of spontaneous movement, able to move freely.

moderately exposed (wave exposure) Generally coasts facing away from prevailing winds and without a long fetch, but where strong winds can be frequent (from Hiscock 1990).

modifier A physical or biological feature or occurrence affecting a site which changes the characteristics of a habitat, e.g. sand-scour, wave surge, substratum mobility, freshwater run-off, grazing, or pollution.
monitoring  The process of repetitive observation, for defined purposes, of one or more elements of the environment, according to prearranged schedules in space and time and using comparable methods for environmental sensing and data collection. Monitoring provides factual information concerning the present state and past trends in environmental behaviour (Based on UNEP definition). The term is also applied to compliance monitoring against accepted standards to ensure that agreed or required measures are followed. (Cf. 'surveillance').

mutualism  A symbiosis in which both organisms benefit, frequently a relationship of complete dependence. (Lincoln et al. 1998) (cf. symbiosis, commensalism, parasite)

national importance  1) biotopes and areas (conservation assessment) Biotopes or areas which are highly rated in the coastal sector will be described as of national importance if they are one of the best examples or only examples known in Great Britain. This was, until 1995, defined for communities as being, "outstandingly good examples of their type in Britain". National importance can apply to biotopes which are, or are likely to be, widely occurring in other similar physiographic situations in the north-eastern Atlantic. (Based on Hiscock & Mitchell 1989). Cf. ‘national importance: species’, ‘international importance’, ‘local importance’, ‘regional importance’ (biotopes or areas and species). 2) species (conservation assessment) Considered to be those benthic species which are nationally rare or nationally scarce (q.v.). Until 1995, defined as: "Species which are recorded at only a few locations in Britain but are more widespread in other parts of the north-east Atlantic. Species recorded in higher numbers at locations under consideration than elsewhere in Britain or where the site is one of a very few locations where large quantities are recorded in Britain." (Based on Hiscock & Mitchell 1989.) A species may also be nationally important where a high proportion of the world population occurs in Britain, even though the species might be widespread in Britain. A nationally important species could be one whose numbers are declining rapidly. Cf. ‘national importance: biotopes and areas’, ‘international importance’, ‘local importance’, ‘regional importance’ (biotopes or areas and species).

nationally rare (species)  For marine conservation purposes, these are regarded as species of limited national occurrence (q.v. rarity). By analogy with the approach adopted in British Red Data Books (for instance, Bratton 1991) but referring to sea areas within the three-mile limit of territorial seas, they are defined as those species known to occur in 0.5% or less (eight or fewer) of the 10 x 10 km squares containing sea within the three-mile limit of territorial seas for Great Britain (Sanderson 1996). Cf. ‘nationally rare’.

nationally scarce (species)  For marine conservation purposes, these are regarded as species of limited national occurrence (q.v. rarity). By analogy with the approach adopted in British Red Data Books (for instance, Bratton 1991) but referring to sea areas within the three-mile limit of territorial seas, they are defined as those species known to occur in 0.5 to 3.5% (nine to 55) of the 10 x 10 km squares containing sea within the three-mile limit of territorial seas for Great Britain (Sanderson 1996). Cf. ‘nationally rare’.

natural habitat  As defined by the Habitats Directive (q.v.) "natural habitats means terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or semi-natural." (Commission of the European Communities 1992).

naturalness (conservation assessment)  The extent to which a location and its associated biotopes is unaffected by anthropogenic activities

natural range  The geographical range of a species in recent times (since about 5,000 BP) but excluding any changes to that range as a result of human agency.

nature conservation  The regulation of human use of the global ecosystem to sustain its diversity of content indefinitely (Nature Conservancy Council 1984).

nekton  Actively swimming pelagic organisms able to move independently of water currents; typically within the size range 20 mm to 20 m (from Lincoln & Boxshall 1987).
neritic Referring to coastal waters overlying the continental shelf (0 m to 200 m below chart datum) (based on Baretta-Bekker et al. 1992).

neuston 1) Organisms similar to plankton, that inhabit the surface film of open water. 2) The ecosystem of the surface film of open water.
niche The ecological resource occupied by a species in a community or ecosystem.
non-native (species) A species which has been introduced directly or indirectly by human agency (deliberate or otherwise), to an area where it has not occurred in recent times (about 5,000 years BP) and which is separate from and lies outside the area where natural range extension could be expected (i.e. outside its natural geographical range (q.v.)). The species has become established in the wild and has self-maintaining populations; the term also includes hybrid taxa derived from such introductions ('derivatives'). (Cf. ‘alien species’; ‘introduced species’; ‘recent colonist’; ‘reintroduction’; ‘translocation’).

oceanodromous Used of organisms that migrate only within the oceanic province (Lincoln et al.1998).
oligohaline Pertaining to brackish water between 0.5 ‰ and 5 ‰ salinity (based on Carriker 1967, in McLusky 1993).
oligotrophic Having low primary productivity; used of water bodies or substrata low in nutrients.
omnivores Animals which feed on a mixed diet including plant and animal material (from Lincoln et al.1998).
onotogenetic migration The occupation by and animal of different habitats at different stages of development (Lincoln et al.1998).
organochlorine chlorinated hydrocarbon A synthetic organic compound containing chlorine, highly toxic and the base for many pesticides. Includes PCBs (polychlorinated biphenyls).
organotin, tributyltin (TBT), triphenyltin A synthetic organic compound containing tin, used as a pesticide particularly to prevent the establishment of fouling organisms, but known to be toxic to certain species even at low concentrations. See ‘imposex’.

oviparous A type of reproduction in animals in which the fertilised eggs are laid or spawned by the mother.

ovoviviparous A type of reproduction in animals in which the embryo(s) develop in persistent membranes and hatch within the maternal body. No nutrition is derived from the mother.
oxycline A horizontal boundary layer in the water column, at which dissolved oxygen content changes sharply with depth.
paralytic shellfish poisoning (PSP) A serious illness affecting organisms with higher nervous systems (vertebrates) caused by eating shellfish which have themselves consumed toxin-producing micro-organisms (usually certain phytoplankton species) and have bioaccumulated the toxins.

parameter Quantity constant in case considered, but varying in different cases (Thompson 1995). An arbitrary constant, as distinguished from a fixed or absolute constant. Any desired numerical value can be given to a parameter. The term is also used to describe a definable characteristic of an item, device or system (Considine 1976). A variable in terms of which it is convenient to express other interrelated variables which may then be regarded as being dependent upon the parameter (Chambers & Chambers 1971).

parasite An organism that lives in or on another living organism (the host), from which it obtains food and other requirements. The host does not benefit from the association and is usually harmed by it. (cf. commensalism, mutualism, symbiosis).
parthenogenesis A form of asexual multiplication in which the ovum develops into a new individual without fertilisation (Barnes et al.1993).
Particularly Sensitive Sea Area  An area that needs special protection through action by IMO because of its significance for recognised ecological or socio-economic or scientific reasons and which may be vulnerable to environmental damage by maritime traffic (International Maritime Organisation 1991).

pedunculate  With the body borne on a stalk (Nichols et al. 1971).

pelagic zone  The open sea and ocean, excluding the sea bottom. Pelagic organisms inhabit such open waters.

penicillate  Brush like (Prescott 1969).

persistence  The continued presence of species or communities at a location (usually inferring in spite of disturbance or change in conditions) (cf. ‘constancy’, ‘stability’, ‘resilience’).

photophilous  Thriving in conditions of strong light (cf. ‘sciophilous’).

photosynthesis  The biochemical process that utilises radiant energy from sunlight to synthesise carbohydrates from carbon dioxide and water in the presence of chlorophyll and other photopigments (based on Lincoln et al. 1998).

phylum  (pl. phyla) A major taxonomic division containing one or more classes.

phyto-  (as prefix, e.g. phytobenthos, phytoplankton) Pertaining to plants.

phytoplankton  Planktonic plant life: typically comprising suspended or motile microscopic algal cells such as diatoms, dinoflagellates and desmids (based on Lincoln & Boxshall 1987).

pinnate  Branching like a feather – an elongate main axis with lateral branches or lobes (Prescott 1969).

pisciform  In the shape of a fish.

plankton  Organisms which drift in the water column and have limited powers of locomotion in comparison with the horizontal water movements. Many benthic animals have planktonic larvae which act as a dispersive phase. (See also holoplankton, meroplankton). (Based on Hawkins & Jones 1992.) (Cf. ‘nekton’).

planktotrophic  Feeding at least in part on materials captured from the plankton (cf. lecithotrophic) (Barnes et al. 1993).

pleuston  Buoyant organisms subject to wind drift. (Baretta-Bekker et al. 1992).

poikilohaline  A term used of organisms having body fluids that conform to external changes in salinity (from Lincoln et al. 1998).

pollution (marine)  "The introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of seawater and reduction of amenities.” (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection - GESAMP - 1995).

polyhaline  Pertaining to brackish water having a salinity between 18 ‰ and 30 ‰ (from McLusky 1993).

polymorphic  Occurrence of different forms (usually morphological) of individuals of the same species.

population  All individuals of one species occupying a defined area and usually isolated to some degree from other similar groups (from Lincoln & Boxshall 1987).

precautionary principle  A principle underlying the concept of sustainable use of resources, which implies that:

a) Prudent action be taken in the absence of scientific certainty;

b) The balance of the burden of proof between the requirement to prove significant damage and the requirement to show no irreversible harm be encouraged;

c) Environmental well-being be given legitimate status and best-practice techniques be developed.

(From WWF Marine Update No. 14, April 1994).
protandrous A condition of hermaphroditism in plants and animals where male gametes mature and are shed before female gametes mature (Holmes 1979).

protists Any organism belonging to the kingdom Protista, including bacteria, protozoans, unicellular algae and fungi, regarded as distinct from plants and animals (from Makins 1991).

protogyny A condition of hermaphroditism in plants and animals where female gametes mature and are shed before male gametes mature (Holmes 1979).

pyncnocline A horizontal boundary layer in the water column at which water density changes sharply with depth, as a result of either a halocline or a thermocline, or both acting together. See ‘stratification’.

radial Symmetrical about any plane passed perpendicular to the oral/aboral axis (Barnes et al. 1993).

rarity (conservation assessment) Seldom found or occurring. ‘Rarity’ needs to take account of the type of distribution and abundance which would be expected of a particular habitat, community, taxonomic group or species and any historical information about past numbers.

rarity (species) "The current status of an organism which, by any combination of biological or physical factors, is restricted either in numbers or area to a level that is demonstrably less than the majority of other organisms of comparable taxonomic entities" (Gaston 1994). (See also ‘nationally rare’, ‘nationally scarce’.)

recent colonist A species which, without any human intervention, has extended its natural geographical range (q.v.) in recent times and which has established new self-maintaining and self-regenerating populations in the wild (cf. ‘non-native’; ‘vagrant’).

recoverability The ability of a habitat, community or individual (or individual colony) of species to redress damage sustained as a result of an external factor.

recruitment (population biology) Term used for the arrival of young in a given population per unit of time (based on Baretta-Bekker et al. 1992).

Red Data Book species A species listed in catalogues published by the IUCN or by national agencies, listing species which are rare, endangered or vulnerable to extinction globally or nationally.


refugium (pl. refugia) Geographical area which has remained isolated from, or unaltered by, climatic or other changes affecting surrounding regions, and that therefore provides a haven for relict (q.v.) species or populations.

regeneration Replacement by compensatory growth and differentiation of lost parts of an organism (Barnes et al. 1993).

regional importance biotopes and areas (conservation assessment) Biotopes or areas which are widespread in similar situations but for which this is a good example in the coastal sector (q.v.) under consideration. Regional importance was, until 1995, defined for communities as being "Communities which are present in similar physiographic situations in Britain but which are outstandingly good examples of their type in the location under consideration, or are as good as examples of similar communities present elsewhere in Britain. Communities recorded at only a few locations in the same biogeographic region." (Davies et al. 1990, based on Hiscock & Mitchell 1989). (Cf. ‘regional importance: species’, ‘international importance’, ‘local importance’, ‘national importance’ (biotopes or areas and species)).
**regional importance (species conservation assessment)** Species which are unrecorded or recorded at only a few locations in similar physiographic situations in other parts of Britain. Species recorded in higher abundance in the site under consideration than in any other part of the region. Species which are at the geographical limits of their distribution might be included in this category. (Davies et al. 1990, based on Hiscock & Mitchell 1989). Cf. ‘regional importance: biotopes or areas’ ‘international importance’, ‘local importance’, ‘national importance’ (biotopes or areas and species).

**reintroduction** A species which has been reintroduced by human agency, deliberate or otherwise, to an area within its natural geographical range (q.v.) but where it had became extinct in historical times.

**relict (species)** A species believed to have been previously more widely distributed but now restricted to a limited number of locations where populations are probably self-sustaining, for example, *Thyasira Gouldi*, *Leptopsammia Pruvoti*.

**representativeness (conservation assessment)** Typical of a feature, habitat or assemblage of species. Representative examples are identified from the range of natural or semi-natural habitats and associated communities (biotopes) within a biogeographically distinct area or the boundaries of a national territory.

**resident** A permanent inhabitant, non-migratory

**resilience** The ability of an ecosystem to return to its original state after being disturbed (from Makins 1991) (cf. ‘constancy’, ‘persistence’, ‘stability’).

**resistance** The degree to which a variable is changed following perturbation (Pimm 1984). The tendency to withstand being perturbed from the equilibrium (Connell & Sousa 1983). (cf. ‘Stability’; ‘adjustment stability’.)

**reticulate** In the form of a mesh or net (Prescott 1969).

**richness (species)** The number of species in a community, habitat or sample (cf. ‘diversity’; ‘evenness’).

**risk assessment** An evaluation of the possibility of undesired events and the probability of harm being caused.

**RoxAnn** An acoustic ground discrimination system, based on sonar, which provides information on seabed relief and features.

**r-strategy** A life strategy which allows a species to deal with the vicissitudes of climate and food supply by responding to suitable conditions with a high rate of reproduction. R-strategists are continually colonising habitats of a temporary nature. (From Baretta-Bekker et al. 1992). Cf. ‘k-strategy’.

**salinity** Measure of the concentration of dissolved salts in seawater, normally expressed as parts per thousand (%). Freshwater is regarded as < 0.5 ‰ (limnetic), seawater as > 30 ‰ (euhaline), and brackish water as intermediate, including oligohaline, mesohaline and polyhaline waters. (Based on McLusky 1993.)

**saltmarsh** Areas of alluvial or peat deposits, colonised by herbaceous and small shrubby terrestrial vascular plants, almost permanently wet and frequently inundated with saline waters (from Long & Mason 1983).

**scavenger** Any organism that feeds on dead organic material.

**sciophilous** Thriving in shaded situations, or in habitats of low light intensity (from Lincoln et al. 1998) (cf. ‘cryptic’, ‘photophilous’).

**scour** The effect of abrasion, usually by sand or gravel, on the seabed.

**seasonal** Showing periodicity related to the seasons (Lincoln et al. 1998).

**sedentary** Attached to a substratum but capable of movement across (or through) it (cf. ‘sessile’).

**segment** A semi-independent, serially repeated unit of the body (Barnes et al. 1993).

**semelparous** Breeding only once then dying (cf. iteroparous) (Barnes et al. 1993).
**semi-quantitative** Measurement based on estimates or rough counts of relative quantity (density, cover) - e.g. abundance scales (cf. ‘quantitative’).

**sensitivity (conservation assessment)** The intolerance of a habitat, community or individual (or individual colony) of a species to damage, or death, from an external factor. See ‘fragility’, ‘vulnerability’.

**sessile** Permanently attached to a substratum (cf. ‘sedentary’).

**sheltered (wave exposure)** Coasts with a restricted fetch and/or open water window. Coasts can face prevailing winds but with a short fetch (< 20km) or extensive shallow area offshore, or may face away from prevailing winds (from Hiscock 1990).

**shore backing** The terrestrial habitat immediately behind the shore.

**Site of Special Scientific Interest (SSSI)** An area of land or water notified by the Nature Conservancy Council or its successor agencies under the Wildlife and Countryside Act 1981 as being of special nature (can include geological) conservation importance.

**solitary** Living alone, not gregarious.

**Special Area of Conservation (SAC)** A site of [European] Community importance designated by the [EU] Member States through a statutory, administrative and/or contractual act where the necessary conservation measures are applied for the maintenance or restoration, at a favourable conservation status, of the natural habitats and/or the populations of the species for which the site is designated (Commission of the European Communities 1992). (This status is achieved by sites adopted by the European Commission.)


**stellate** Arranged like a star.

**stenohaline** Tolerance of only a narrow range of salinities (from Lincoln & Boxshall 1987).

**stenothermal** Tolerance of a narrow range of temperatures.

**stochastic (statistics)** Of a random variable. Having a probability of distribution, usually with finite variance.

**straplike** Ribbonlike, in the form of a strap or ribbon.

**Strategic Environmental Assessment (SEA)** The formalised, systematic and comprehensive process of evaluating the environmental impacts of a policy, plan or programme and its alternatives, including the preparation of a report on the evaluation and the use of the findings in publicly-accountable decision-making (Pritchard 1993) (cf. ‘Environmental Assessment’).

**stratum (ecological)** (pl. strata) A horizontal layer of vegetation within a stratified plant community (from Lincoln & Boxshall 1987).

**stress** “A chemical or physical process that leads to a response within an organism, or at the levels of whole organisms or assemblages” (from Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection - GESAMP - 1995).

**sublittoral** The zone exposed to air only at its upper limit by the lowest spring tides, although almost continuous wave action on extremely exposed coasts may extend the upper limit high into the intertidal region. The sublittoral extends from the upper limit of the large kelps and includes, for practical purposes in nearshore areas, all depths below the littoral. Various subzones are recognised. (Based on Hiscock 1985.) (Cf. ‘subtidal’).

**sublittoral fringe** The upper part of the sublittoral zone which is uncovered by the tide. On hard substrata, the zone is characterised by the kelps Laminaria digitata and Alaria esculenta. The lower limit of this zone is marked by the upper limit of the truly sublittoral kelp Laminaria hyperborea. This species assemblage does not occur on all British coasts. (Based on Lewis 1964.)
substratum (pl. substrata) Material available for colonisation by plants and animals; a more correct term in this context than ‘substrate’.

succession Sequential development of plant or animal communities through time.

supralittoral The lower terrestrial zone, characteristically dominated by orange and white-to-grey lichens on hard substrata with scattered salt-tolerant higher plants and mosses (from Hiscock 1990).

surrogate species Species which are likely to change if the whole community is changing and therefore respond to change on behalf of the community.

surveillance A procedure by which a series of surveys is conducted in a sufficiently rigorous manner for changes in the attributes of a site (or species) to be detected over a period of time. Surveillance is often conducted to identify normal background variation (‘noise’) in order that abnormal changes can be identified by a monitoring programme. (From Marine Conservation Monitoring Workshop, January 1993.) The term is also applied to compliance surveillance to ensure that agreed or required measures are followed. (See also ‘survey’. Cf. ‘monitoring’).

survey An inventory of the attributes of a site, area or region in terms of habitat and associated organisms (or of the distribution and/or autecological characteristics of selected species), usually by means of a standardised procedure. (Based on Marine Conservation Monitoring Workshop, January 1993.)

suspension feeders Suspensivores, filter-feeders, any organisms which feed on particulate organic matter, including plankton, suspended in the water column (from Lincoln et al. 1998).

sustainability (environmental) Maintaining the environment's natural qualities and characteristics and its capacity to fulfil its full range of functions, including maintenance of biodiversity (from English Nature, Planning for environmental sustainability, June 1994).

sustainable development "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development 1987 ( Brundtland Report)).

symbiosis The living together in a constant and definite relationship of two different organisms (cf. commensalism, mutualism, parasite) (Brusca 1980).

syneceology The study of the ecology of groupings of organisms, populations, communities or systems; ecological sociology (based on Lincoln et al. 1998) (cf. ‘autecology’).

taxon (pl. taxa) A taxonomic group of any rank, including all its subordinate groups; may be a single species or a group of related species, e.g. genus, class, order, etc., considered to be sufficiently distinct from other such groups to be treated as a separate unit (based on Lincoln & Boxshall 1987 and Fitter & Manuel 1986).

taxonomy The branch of biology concerned with the classification of organisms into groups (taxa) based on similarities of structure, origin, etc.

terrestrial Living on, or referring to, land.

tidal stream The alternating horizontal movement of water associated with the rise and fall of the tide (from Lincoln & Boxshall 1987) (cf. ‘current’).

tide The periodic vertical movement of water level with respect to some point on land. See ‘astronomical tide’.

toxicology The branch of science concerned with poisons, their nature, effects and antidotes (from Makins 1991). ‘Ecotoxicology’ is the application of toxicology to the natural environment.

tributyl tin (TBT) (See ‘organotin’).

tubicolous Tube dwelling (Barnes et al.1993).

turbinate Whorled (Brusca 1980).

turf The lowest stratum of erect branching or filiform species.

typicalness (conservation assessment) See ‘Representativeness’.

52
ultra-sheltered (wave exposure) Fully enclosed coasts with a fetch measured in tens or at most a few hundred metres (from Hiscock 1990).

understorey, undergrowth layer Organisms occurring under the main canopy of algae, especially of kelps (from Hawkins & Jones 1992).

vagile Wandering; freely motile, mobile. (cf. ‘sessile’).

vagility The tendency of an organism or population to change its location or distribution with time; mobility.

vagrant (species) Individuals of a species which, by natural means, move from one geographical region to another outside their usual range, or away from usual migratory routes, and which do not establish a self-maintaining, self-regenerating population in the new region (cf. ‘alien species’; ‘recent colonist’).

vermiform Wormlike, long and slender like a worm (Brusca 1980).

very exposed (wave exposure) 1) Open coasts which face into prevailing winds and which receive wind-driven waves and oceanic swell without any offshore obstructions for several hundred kilometres, but where deep water is not close to the shore (50m depth contour further than about 300m).
2) Open coasts adjacent to extremely exposed sites but which face away from prevailing winds. (From Hiscock 1990.)

very sheltered (wave exposure) Coasts with a fetch less than about 3 km where they face prevailing winds or about 20 km where they face away from prevailing winds, or which have offshore obstructions such as reefs or a narrow (<30°) open water window (based on Hiscock 1990.)

viviparous A type of reproduction in animals in which the embryo(s) develop within and derive nourishment from the maternal body.

vulnerability The likelihood that a habitat, community or individual (or individual colony) of a species will be exposed to an external factor to which it is sensitive. See ‘Sensitivity’.

vulnerable (IUCN Red List categories) A taxon which is not ‘Critically endangered’ (q.v.) or ‘Endangered’ (q.v.) but is facing a high risk of extinction in the wild in the medium term future (International Union for the Conservation of Nature and Natural Resources 1994) (cf. ‘Extinct’, ‘Critically endangered’, ‘Endangered’).

water quality 1) The nature of a body of water in terms of its physical (for instance, suspended sediment load) and chemical (for instance, salinity) characteristics.
2) The degree of contamination of water. See ‘classification (water quality)’.

whiplike In the form of a whip.

zooid One of the individual animals connected together in a common mass constituting a colony (based on Fitter & Manuel 1986).

zooplankton The animal component of the plankton (Lincoln et al.1998).
### Typical abundance of a species in Britain and Ireland:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Species that are found in high numbers in their appropriate habitats. Equivalent to Superabundant and Abundant on the MNCR SACFOR abundance scale</td>
</tr>
<tr>
<td>Moderate</td>
<td>Species that are found in moderate numbers in their appropriate habitats. Equivalent to Common and Frequent on the MNCR SACFOR abundance scale</td>
</tr>
<tr>
<td>Low</td>
<td>Species that are found in low numbers in their appropriate habitats. Equivalent to Occasional and Rare on the MNCR SACFOR abundance scale</td>
</tr>
<tr>
<td>Very low</td>
<td>Less than rare on the MNCR SACFOR abundance scale</td>
</tr>
</tbody>
</table>

### Mobility and attachment type:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swimmer</td>
<td>An organism that moves through the water column via movements of its fins, legs or appendages, via undulatory movements of the body or via jet propulsion (e.g. Gadus, Loligo).</td>
</tr>
<tr>
<td>Crawler</td>
<td>An organism that moves along on the substratum via movements of its legs, appendages or muscles (e.g. Carcinus).</td>
</tr>
<tr>
<td>Burrower</td>
<td>An organism that lives or moves in a burrow (e.g. Arenicola).</td>
</tr>
<tr>
<td>Drifter</td>
<td>An organism whose movement is dependent on wind or water currents (e.g. Aurelia).</td>
</tr>
<tr>
<td>Permanent attachment</td>
<td>Non-motile; permanently attached at the base (Lincoln, Boxshall and Clark 1998)(e.g. Caryophyllia)</td>
</tr>
<tr>
<td>Temporary attachment</td>
<td>Temporary / sporadic attachment. Attached to a substratum but capable of movement across (or through) it (e.g. Actinia)</td>
</tr>
</tbody>
</table>

### Sociability:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solitary</td>
<td>Living alone, not gregarious (Thompson 1995).</td>
</tr>
<tr>
<td>Gregarious</td>
<td>Living in groups or communities, growing in clusters (Thompson 1995).</td>
</tr>
<tr>
<td>Colonial</td>
<td>Descriptive of organisms produced asexually which remain associated with each other; in many animals, retaining tissue contact with other polyps or zooids as a result of incomplete budding (Barnes et al. 1996).</td>
</tr>
</tbody>
</table>
### Environmental position:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epifauna / flora</td>
<td>Animals / plants living on the surface of the seabed.</td>
</tr>
<tr>
<td>Infauna</td>
<td>Benthic animals which live within the seabed.</td>
</tr>
<tr>
<td>Interstitial</td>
<td>Relating to the system of cavities and channels formed by the spaces between grains in a sediment (interstitial space).</td>
</tr>
<tr>
<td>Demersal</td>
<td>Living at or near the bottom of a sea or lake, but having the capacity for active swimming (from Lincoln, Boxshall &amp; Clark 1982).</td>
</tr>
<tr>
<td>Pelagic</td>
<td>Inhabiting the open waters of the sea or ocean, excluding the bottom layers.</td>
</tr>
</tbody>
</table>

### Growth forms:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boring</td>
<td>Makes an excavation (through physical or chemical action) in which to live.</td>
</tr>
<tr>
<td>Crustose</td>
<td>Forming or resembling a crust (Thompson 1995).</td>
</tr>
<tr>
<td>Flaccid</td>
<td>Soft, limp, flabby (Brusca 1980).</td>
</tr>
<tr>
<td>Massive</td>
<td>Bulky (Homes 1979).</td>
</tr>
<tr>
<td>Cushion</td>
<td>A mass or pillow of soft material.</td>
</tr>
<tr>
<td>Turf</td>
<td>The lowest stratum of erect branching or filiform species.</td>
</tr>
<tr>
<td>Foliose</td>
<td>Bearing leaves or leaf-like structures; having the appearance of a leaf.</td>
</tr>
<tr>
<td>Shrub</td>
<td>Having a very short stem with branches near the ground (Thompson 1995).</td>
</tr>
<tr>
<td>Arborescent / Arbuscular</td>
<td>Having the shape or characteristics of a tree.</td>
</tr>
<tr>
<td>Forest</td>
<td>A large number or dense mass of vertical objects (Thompson 1995).</td>
</tr>
<tr>
<td>Accretion</td>
<td>Build up or accumulation of sediment.</td>
</tr>
<tr>
<td>Radial</td>
<td>Symmetrical about any plane passed perpendicular to the oral/aboral axis (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Stellate</td>
<td>Arranged like a star.</td>
</tr>
<tr>
<td>Whiplike</td>
<td>In the form of a whip.</td>
</tr>
<tr>
<td>Straplike / Ribbonlike</td>
<td>In the form of a strap or ribbon.</td>
</tr>
<tr>
<td>Filiform / Filamentous</td>
<td>Slender and thread-like (Kozloff 1996).</td>
</tr>
<tr>
<td>Vermiform</td>
<td>Wormlike, long and slender like a worm (Brusca 1980).</td>
</tr>
</tbody>
</table>
### Growth forms (continued)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digitate</td>
<td>Having parts arranged like fingers on a hand (Holmes 1979).</td>
</tr>
<tr>
<td>Penicillate</td>
<td>Brush like (Prescott 1969).</td>
</tr>
<tr>
<td>Pinnate</td>
<td>Branching like a feather – an elongate main axis with lateral branches or lobes (Prescott 1969).</td>
</tr>
<tr>
<td>Capitate / Clubbed</td>
<td>Enlarged or swollen at the apex, with a ‘head’, clubbed. (Prescott 1969).</td>
</tr>
<tr>
<td>Clathrate</td>
<td>Latticed (Holmes 1979).</td>
</tr>
<tr>
<td>Reticulate</td>
<td>In the form of a mesh or net (Prescott 1969).</td>
</tr>
<tr>
<td>Funnel shaped</td>
<td>In the shape of a funnel.</td>
</tr>
<tr>
<td>Dendroid</td>
<td>Branching irregularly – similar to that of a root system (Prescott 1969).</td>
</tr>
<tr>
<td>Flabellate</td>
<td>Shaped like a fan, fanlike (Brusca 1980).</td>
</tr>
<tr>
<td>Tubicolous</td>
<td>Tube dwelling (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Medusiform / Medusoid</td>
<td>Disk, bell or umbrella shaped and often gelatinous (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Cylindrical</td>
<td>With straight sides and a circular section (Thompson 1995).</td>
</tr>
<tr>
<td>Globose</td>
<td>Spherical / ovoid / globular (Brusca 1980).</td>
</tr>
<tr>
<td>Bullate / Saccate</td>
<td>Balloon or sac-like (Prescott 1969).</td>
</tr>
<tr>
<td>Articulate</td>
<td>Jointed, arthrous (Holmes 1979).</td>
</tr>
<tr>
<td>Bivalved</td>
<td>Characteristically a shell of two calcareous valves joined by a flexible ligament.</td>
</tr>
<tr>
<td>Turbinate</td>
<td>Whorled (Brusca 1980).</td>
</tr>
<tr>
<td>Pisciform</td>
<td>Fishlike.</td>
</tr>
</tbody>
</table>
### Feeding method:

<table>
<thead>
<tr>
<th>Feeding method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Autotroph</strong></td>
<td>Primary producer, an organism that synthesises complex organic substances from simple inorganic substrates using energy from sunlight (e.g. Seaweeds).</td>
</tr>
<tr>
<td><strong>Suspension Feeder</strong></td>
<td>Any organism which feeds on particulate organic matter, including plankton, suspended in the water column (from Lincoln, Boxshall &amp; Clark 1982).</td>
</tr>
<tr>
<td><strong>Active</strong></td>
<td>Catching food on a filter from water by actively sweeping (e.g. <em>Porcellana platychelyes</em>) or pumping (e.g. sea squirts, many bivalve molluscs).</td>
</tr>
<tr>
<td><strong>Passive</strong></td>
<td>Catching food on a filter held into flowing water (e.g. hydroids, sea fans, sea pens), or collecting the ‘rain’ of detritus on sticky apparatus other than a filter (e.g. <em>Cucumaria frondosa</em>).</td>
</tr>
<tr>
<td><strong>Deposit Feeder</strong></td>
<td>Any organism which feeds on fragmented particulate organic matter from the substratum; detritivores (from Lincoln, Boxshall &amp; Clark 1982).</td>
</tr>
<tr>
<td><strong>Surface</strong></td>
<td>Obtaining food from the surface of the substratum (e.g. <em>Corophium volutator</em>).</td>
</tr>
<tr>
<td><strong>Sub-surface</strong></td>
<td>Obtaining food from within the substratum (e.g. <em>Echinocardium cordatum</em>).</td>
</tr>
<tr>
<td><strong>Carnivore</strong></td>
<td>Feeding on animals</td>
</tr>
<tr>
<td><strong>Active</strong></td>
<td>Catching live animal food through active searching or ambushing.</td>
</tr>
<tr>
<td><strong>Passive</strong></td>
<td>Catching live animal food that happens to make contact with a trap mechanism.</td>
</tr>
<tr>
<td><strong>Omnivore</strong></td>
<td>Animal which feeds on a mixed diet including plant and animal material (from Lincoln, Boxshall &amp; Clark 1982).</td>
</tr>
<tr>
<td><strong>Active</strong></td>
<td>Consuming live animal or plant food through active searching or ambushing.</td>
</tr>
<tr>
<td><strong>Passive</strong></td>
<td>Consuming live animal or plant food that happens to make contact with a trap mechanism.</td>
</tr>
<tr>
<td><strong>Herbivore</strong></td>
<td>An organism which feeds on plants, including phytoplankton.</td>
</tr>
<tr>
<td></td>
<td>Grazing on seaweeds, diatoms or bacterial films (e.g. limpets, <em>Hydrobia ulva</em>).</td>
</tr>
<tr>
<td><strong>Saprophage / scavenger</strong></td>
<td>Any organism that actively feeds on dead organic material (e.g. crabs, whelks).</td>
</tr>
<tr>
<td><strong>Symbiont contribution</strong></td>
<td>Where some dietary component(s) are provided by symbiotic organisms (e.g. <em>Anemonia</em> with zooxanthellae)</td>
</tr>
<tr>
<td><strong>Parasite</strong></td>
<td>An organism that lives in or on another living organism (the host), from which it obtains food and other requirements (e.g. Leeches).</td>
</tr>
</tbody>
</table>
**Mode of life:**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent</td>
<td>Any organism not relying on another for food (except as prey), environment or livelihood.</td>
</tr>
<tr>
<td>Parasite</td>
<td>An organism that lives in or on another living organism (the host), from which it obtains food and other requirements. The host does not benefit from the association and is usually harmed by it.</td>
</tr>
<tr>
<td>Mutualist</td>
<td>A partner in a symbiosis where both organisms benefit, frequently a relationship of complete dependence. (Lincoln, Boxshall and Clarke 1982)</td>
</tr>
<tr>
<td>Inquilinist</td>
<td>A partner in a symbiotic association which lives in close association with another, generally in the tube or burrow or actually within a body chamber of the host (Brusca 1980).</td>
</tr>
<tr>
<td>Commensal</td>
<td>A partner in a symbiosis in where one species derives benefit from a common food supply, whilst the other species is not adversely affected (Lincoln, Boxshall &amp; Clark 1982).</td>
</tr>
<tr>
<td>Host</td>
<td>An animal or plant with a parasitic, commensal, mutualist or inquilinist dependent on it (from Fowler and Fowler 1995).</td>
</tr>
</tbody>
</table>

**Physiographic type:** (from Hiscock 1996)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Coast</td>
<td>Any part of the coast not within a marine inlet, strait or lagoon, including offshore rocks and small islands. This includes MNCR types; Linear coast, Islands / Rocks and Semi-enclosed coast.</td>
</tr>
<tr>
<td>Offshore seabed</td>
<td>Seabed beyond three miles (5km) from the shore.</td>
</tr>
<tr>
<td>Strait/Sound</td>
<td>Channels between the mainland and an island or between two islands which are open at both ends to the open coast (it does not refer to similar features or narrows within marine inlets).</td>
</tr>
<tr>
<td>Sealoch</td>
<td>Glacially formed inlets (fjords, fjards) of western Scotland and Ireland; typically elongate and deepened by glacial action with little freshwater influence. Often with narrows and sills dividing the loch into a series of basins.</td>
</tr>
<tr>
<td>Ria/Voe</td>
<td>Drowned river valleys of south-west Britain (ria) and Shetland (voe). Often with a greater presence of rock and more marine in character than estuaries.</td>
</tr>
<tr>
<td>Estuary</td>
<td>Downstream part of a river where it widens to enter the sea; often with significant freshwater influence and predominantly comprising sediment habitats.</td>
</tr>
<tr>
<td>Isolated Saline Water (Lagoon)</td>
<td>Enclosed bodies of water, separated or partially separated from the sea by shingle, sand or sometimes rock and with a restricted exchange of water with the sea, yielding varying salinity regimes.</td>
</tr>
<tr>
<td>Enclosed Coast / Embayment</td>
<td>Any other sort of enclosed coast not covered by the definitions above such as harbours or marinas.</td>
</tr>
</tbody>
</table>
MarLIN: Assessing seabed species and ecosystems sensitivities. Existing approaches and development

Biological Zones: (from Hiscock 1990)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supralittoral</td>
<td>The lower terrestrial zone, characteristically dominated by orange and white-to-grey lichens on hard substrata with scattered salt-tolerant higher plants and mosses.</td>
</tr>
<tr>
<td>Upper Littoral Fringe</td>
<td>This is colonised by <em>Verrucaria maura</em> with <em>Littorina saxatilis</em> and <em>Littorina neritoides</em> often present. May include saltmarsh species on shale/pebbles in shelter.</td>
</tr>
<tr>
<td>Lower Littoral Fringe</td>
<td>The <em>Pelvetia/Porphyra</em> belt with patchy <em>Verrucaria maura</em> and <em>Fucus spiralis</em> (on sheltered shores). <em>Fucus disticus</em> and <em>Fucus spiralis nana</em> occurs on extremely exposed shores in the NE. <em>Verrucaria. mucosa</em> present above the main barnacle population. May also include saltmarsh species on shale/pebbles in shelter.</td>
</tr>
<tr>
<td>Upper Eulittoral</td>
<td>Barnacles and limpets present in quantity with <em>Fucus vesiculosus</em> and <em>Ascophyllum</em> although often this belt has only sparse algal cover compared with the lower eulittoral.</td>
</tr>
<tr>
<td>Mid Eulittoral</td>
<td>Barnacle - limpet dominated, sometimes mussels, with <em>Fucus vesiculosus</em> and *Ascophyllum nodosum. <em>Mastocarpus stellatus</em> and <em>Palmaria palmata</em> patchy in lower part. Usually quite a wide belt.</td>
</tr>
<tr>
<td>Lower Eulittoral</td>
<td><em>Fucus serratus, Mastocarpus stellatus, Himanthalia elongata and Palmaria palmata</em> present; sparse barnacles. Patchy <em>Alaria</em>.</td>
</tr>
<tr>
<td>Sublittoral Fringe</td>
<td>Dominated by <em>Alaria esculenta, Laminaria digitata or L. saccharina</em> with sparse barnacles and encrusting Rhodophycota.</td>
</tr>
<tr>
<td>Upper Infra littoral</td>
<td>Kelp forest.</td>
</tr>
<tr>
<td>Lower Infra littoral</td>
<td>Sparse or no kelp , dominated by foliose algae except where grazed.</td>
</tr>
<tr>
<td>Upper Circalittoral</td>
<td>Dominated by animals with sparse foliose algae except where grazed.</td>
</tr>
<tr>
<td>Lower Circalittoral</td>
<td>Dominated by animals with no foliose algae but encrusting Rhodophycota patchy in grazed areas.</td>
</tr>
</tbody>
</table>

Substratum:
The substratum types defined below are categories which may support distinctive biotopes or that certain species favour or are characteristic of. These categories are modified from the Wentworth and Folk classifications. Distinctive habitats which are not directly linkable to substratum, but which hold or may hold distinctive biotopes or particular species, are included. The habitats listed are based in part on the descriptive term used for the names of biotopes in the MNCR biotopes classification.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bedrock</strong></td>
<td>Any stable hard substratum, not separated into boulders or smaller sediment units. Includes soft rock-types such as chalk, peat and clay</td>
</tr>
<tr>
<td><strong>Large to very large boulders</strong></td>
<td>&gt;512 mm. Likely to be stable</td>
</tr>
<tr>
<td><strong>Small boulders</strong></td>
<td>256 - 512 mm. May be unstable.</td>
</tr>
<tr>
<td><strong>Cobbles</strong></td>
<td>64-256 mm. May be rounded to flat. Substrata that are predominantly cobbles.</td>
</tr>
<tr>
<td><strong>Pebbles</strong></td>
<td>16-64 mm. May be rounded to flat. Substrata which are predominantly pebbles.</td>
</tr>
<tr>
<td><strong>Gravel / shingle</strong></td>
<td>4-16 mm Clean stone or shell gravel including dead maerl.</td>
</tr>
<tr>
<td><strong>Maerl</strong></td>
<td>Live maerl. <em>Phymatolithon calceatum</em> and <em>Lithothamnion corallioides</em> in Britain and Ireland.</td>
</tr>
<tr>
<td><strong>Muddy gravel</strong></td>
<td>10 - 80 % gravel, 20 - 90 % mud.</td>
</tr>
<tr>
<td><strong>Coarse clean sand</strong></td>
<td>0.5 - 4 mm. &gt; 90 % sand.</td>
</tr>
<tr>
<td><strong>Fine clean sand</strong></td>
<td>0.063 - 0.5 mm. &gt;90 % sand.</td>
</tr>
<tr>
<td><strong>Sandy mud</strong></td>
<td>50 - 90 % sand, 10 - 50 % mud.</td>
</tr>
<tr>
<td><strong>Muddy sand</strong></td>
<td>50 - 90 % mud, 10 - 50 % sand.</td>
</tr>
<tr>
<td><strong>Mud</strong></td>
<td>&lt;0.063 mm (silt / clay fraction).</td>
</tr>
<tr>
<td><strong>Mixed</strong></td>
<td>Mixtures of a variety of sediment types. Pebble / gravel / sand / mud.</td>
</tr>
<tr>
<td><strong>Algae</strong></td>
<td>E.g. <em>Laminaria</em></td>
</tr>
<tr>
<td><strong>Biogenic reef</strong></td>
<td>An elevated structure on the seabed built by calcareous or other concretion-forming organisms, or by chemical precipitation (Hiscock 1996) For example by <em>Modiolus</em> or <em>Sabellaria</em>.</td>
</tr>
<tr>
<td><strong>Artificial</strong></td>
<td>E.g. wood, metal or concrete</td>
</tr>
<tr>
<td><strong>Water column</strong></td>
<td>The vertical column of water in a sea or lake extending from the surface to the bottom (Lincoln <em>et al.</em> 1998).</td>
</tr>
<tr>
<td><strong>Salt marsh</strong></td>
<td>A flat, poorly drained coastal swamp inundated by most high tides. (Lincoln <em>et al.</em> 1998).</td>
</tr>
<tr>
<td><strong>Strandline</strong></td>
<td>A line on the shore composing debris deposited by a receding tide; commonly used to denote the line of debris at the level of extreme high water (Lincoln <em>et al.</em> 1998).</td>
</tr>
<tr>
<td><strong>Seagrass</strong></td>
<td>Habitat associated with seagrass bed communities.</td>
</tr>
</tbody>
</table>
**Substratum (continued):**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under boulders</td>
<td>Habitat associated with the underside of boulders.</td>
</tr>
<tr>
<td>Crevices / fissures</td>
<td>Narrow openings (Thompson 1995).</td>
</tr>
<tr>
<td>Rockpools</td>
<td>A pool of water among rocks left behind by an ebbing tide.</td>
</tr>
<tr>
<td>Caves</td>
<td>A large hollow in the side of a vertical rock face or cliff.</td>
</tr>
<tr>
<td>Overhangs</td>
<td>An overhanging part of a rock formation (Thompson 1995).</td>
</tr>
<tr>
<td>No preference</td>
<td></td>
</tr>
</tbody>
</table>

**Wave exposure:** (from Hiscock 1990).

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely exposed</td>
<td>Open coastlines which face into the prevailing wind and receive both wind-driven waves and swell without any offshore obstructions such as islands or shallows for several thousand kilometres and where deep water is close to the shore (50 m depth contour within about 300 m).</td>
</tr>
</tbody>
</table>
| Very exposed        | 1) Open coasts which face into prevailing winds and which receive wind-driven waves and oceanic swell without any offshore obstructions for several hundred kilometres, but where deep water is not close to the shore (50 m depth contour further than about 300 m)  
                        2) Open coasts adjacent to extremely exposed sites but which face away from prevailing winds. |
| Exposed             | 1) Coasts which face the prevailing wind but which have a degree of shelter because of extensive shallow areas offshore, offshore obstructions, or a restricted (less than 90°) window to open water. These sites are not generally exposed to large waves or regular swell.  
                        2) Open coasts facing away from prevailing winds but with a long fetch, and where strong winds are frequent. |
| Moderately exposed  | Generally coasts facing away from prevailing winds and without a long fetch, but where strong winds can be frequent (from Hiscock 1990). |
| Sheltered           | Coasts with a restricted fetch and/or open water window. Coasts can face prevailing winds but with a short fetch (< 20 km) or extensive shallow area offshore, or may face away from prevailing winds. |
| Very sheltered      | Coasts with a fetch less than about 3 km where they face prevailing winds or about 20 km where face away from prevailing winds, or which have offshore obstructions such as reefs or a narrow (< 30° open water window. |
| Extremely sheltered | Fully enclosed coasts with a fetch of no more than about 3 km.                                                                          |
| Ultra sheltered     | Fully enclosed coasts with a fetch measured in tens or at most a few hundred metres.                                                   |
### Tidal stream exposure:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very strong</td>
<td>&gt; 6 knots</td>
</tr>
<tr>
<td>Strong</td>
<td>3 to 6 knots</td>
</tr>
<tr>
<td>Moderately strong</td>
<td>1 to 3 knots</td>
</tr>
<tr>
<td>Weak</td>
<td>&lt; 1 knot</td>
</tr>
<tr>
<td>Very weak</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

### Salinity:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full salinity</td>
<td>30-40 ppt</td>
</tr>
<tr>
<td>Variable salinity</td>
<td>18-40 ppt</td>
</tr>
<tr>
<td>Reduced salinity</td>
<td>18-30 ppt</td>
</tr>
<tr>
<td>Low salinity</td>
<td>&lt;18 ppt</td>
</tr>
<tr>
<td>Unknown Salinity</td>
<td>?</td>
</tr>
</tbody>
</table>

### Migration:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident / Non-migratory</td>
<td>Remaining within the same area (from Lincoln et al. 1998).</td>
</tr>
<tr>
<td>Seasonal (feeding)</td>
<td>A seasonal migration for the purpose of following or moving to suitable feeding grounds.</td>
</tr>
<tr>
<td>Seasonal (reproduction)</td>
<td>A seasonal migration in order to reproduce.</td>
</tr>
<tr>
<td>Seasonal (environment)</td>
<td>A seasonal migration in order to remain with suitable environmental conditions.</td>
</tr>
<tr>
<td>Diel</td>
<td>Daily, pertaining to a 24 hour period.</td>
</tr>
<tr>
<td>Passive</td>
<td>A migration undertaken through the effects of tide, current or wind.</td>
</tr>
<tr>
<td>Active</td>
<td>A migration undertaken by active movement across the substratum or through the water column.</td>
</tr>
</tbody>
</table>
### Reproductive type / life history:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budding</td>
<td>A form of asexual multiplication in which a new individual begins life as an outgrowth from the body of the parent. It may then separate to lead an independent existence or remain connected or otherwise associated to form a colonial organism (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Parthenogenesis</td>
<td>A form of asexual multiplication in which the ovum develops into a new individual without fertilisation (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Fission</td>
<td>Form of asexual multiplication involving division of the body into two or more parts each or all of which can grow into new individuals (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Permanent hermaphrodite</td>
<td>Capable of producing both ova and spermatozoa either at the same time (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Protandrous hermaphrodite</td>
<td>A condition of hermaphroditism in plants and animals where male gametes mature and are shed before female gametes mature (Holmes 1979).</td>
</tr>
<tr>
<td>Protogynous hermaphrodite</td>
<td>A condition of hermaphroditism in plants and animals where female gametes mature and are shed before male gametes mature (Holmes 1979).</td>
</tr>
<tr>
<td>Gonochoristic</td>
<td>Having separate sexes (Barnes, Calow and Olive 1988).</td>
</tr>
</tbody>
</table>

### Frequency of reproduction:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semelparous</td>
<td>Breeding only once then dying (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>&lt; Biannual</td>
<td>Breeds less frequently than every two years.</td>
</tr>
<tr>
<td>Biannual episodic</td>
<td>Breeds every second year but in one or more discrete periods initiated by some trigger (for example a lunar cycle).</td>
</tr>
<tr>
<td>Biannual protracted</td>
<td>Breeds once every two years over an extended or drawn out period.</td>
</tr>
<tr>
<td>Annual episodic</td>
<td>Breeds every year but in one or more discrete periods initiated by some trigger (for example a lunar cycle).</td>
</tr>
<tr>
<td>Annual protracted</td>
<td>Breeds every year over an extended or drawn out period.</td>
</tr>
</tbody>
</table>
Developmental mechanism:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oviparous</td>
<td>A type of reproduction in animals in which the fertilised eggs are laid or spawned by the mother.</td>
</tr>
<tr>
<td>Planktotrophic</td>
<td>Feeding at least in part on materials captured from the plankton (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Lecithotrophic</td>
<td>Development at the expense of internal resources (i.e. yolk) provided by the female (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Direct development</td>
<td>Development without a larval stage (Barnes, Calow and Olive 1988).</td>
</tr>
<tr>
<td>Ovovivparous</td>
<td>A type of reproduction in animals in which the embryo(s) develop in persistent membranes and hatch within the maternal body. No nutrition is derived from the mother.</td>
</tr>
<tr>
<td>Viviparous</td>
<td>A type of reproduction in animals in which the embryo(s) develop within and derive nourishment from the maternal body.</td>
</tr>
</tbody>
</table>

Management regime:

<table>
<thead>
<tr>
<th>Regime</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quota or take limited by numbers</td>
<td>Restrictions based on limits to the numbers of individuals taken. For example the ‘Total Allowable Catch’ system applied to fisheries in the EU</td>
</tr>
<tr>
<td>Quota or take limited by effort</td>
<td>Restrictions based on limits to the numbers of individuals/boats/nets etc doing the collecting or the amount of time spent collecting.</td>
</tr>
<tr>
<td>Restriction of movements of this species</td>
<td>Limiting the movements / transportation of a species in order to prevent its spread/ colonisation etc. where it may be undesirable</td>
</tr>
<tr>
<td>Restriction of movements of likely hosts of this species</td>
<td>Limiting the spread/ colonisation etc. of a species to where it may be undesirable by restricting the movements / transportation of its host(s)</td>
</tr>
<tr>
<td>Technical restriction in methods of collection</td>
<td>Restrictions such as limiting the size of individuals taken, for example mesh size of nets.</td>
</tr>
<tr>
<td>Habitat conservation - maintenance</td>
<td>Efforts to preserve the habitat or environment in its current state.</td>
</tr>
<tr>
<td>Habitat conservation - enhancement</td>
<td>Efforts to improve the condition of the habitat or environment, restoration to its original state.</td>
</tr>
<tr>
<td>Re-introduction</td>
<td>Deliberate re-introduction by human intervention of a species to an area within its natural geographical range but where it has become extinct in historical times.</td>
</tr>
<tr>
<td>Ex-situ breeding</td>
<td>Safeguarding the existence of a population through breeding programmes outside of its natural habitat e.g. captive breeding programmes.</td>
</tr>
</tbody>
</table>
Appendix 3. Key to acronyms

Acronyms likely to be used in relation to studies of sensitivity and identification of marine natural heritage importance of areas are given below.

Terms are briefly explained where they are not referenced in the glossary above and are unclear. The inclusion here of environmental consultants and other commercial organisations merely represents some of the many contractors who have been involved with work on sensitivity and whose names are regularly abbreviated in reports. The inclusion or exclusion of any such organisation is not intended as an endorsement or otherwise of their work.

ACME Advisory Committee on the Marine Environment (an ICES committee)
AONB Area of Outstanding Natural Beauty
AOS Area of Search (in relation to SSSI selection)
ASMO ASsessment and MOnitoring group (of the Oslo and Paris Conventions)
ASP Active Server Pages. Active Server Pages is a compile-free application environment for Microsoft’s Web Server. ASP scripts can be embedded in an HTML document and are parsed before being sent to the client web browser. Active Server Pages provide a method to create dynamic or database driven web pages. Active Server Pages have native support for both VBScript and Jscript and can also embed ActiveX server components.
ASSI Area of Special Scientific Interest (Northern Ireland)
ATBA Areas To Be Avoided (by shipping)
BEDMAN BEnthic Data MANagement. (A database developed at the Dutch National Institute for Coastal and Marine Management and the Netherlands Institute of Ecology to hold survey data on macro- and meiobenthic fauna from the North Sea.)
BGS British Geological Survey
BioMar (Not an acronym) Marine coastal zone management: Identification, description and mapping of biotopes (an EU LIFE-funded project). (Not to be confused with the USA biodiversity and systematics research programme BioMar: BIOlogical diversity in MARine systems).
BOD biochemical oxygen demand
BODC British Oceanographic Data Centre
BRC Biological Records Centre
CA countryside agency - one of the statutory national nature conservation bodies, the Countryside Council for Wales, English Nature or Scottish Natural Heritage
CAMEO Computer-Aided Management of Emergency Operations
CANOCO CANOnical Community Ordination (a multivariate analytical programme)
CCMS Centre for Coastal and Marine Sciences (of NERC)
CCW Countryside Council for Wales
CGI Common Gateway Interface. A way of interfacing computer programs with HTTP or WWW servers, so that a server can offer interactive sites instead of just static text and images.
CITES Convention on International Trade in Endangered Species
CORINE Co-ORDination of INformation on the Environment (an EU biotopes classification initiative)
COST COoperation européenne dans la domaine de la recherché Scientifique et Technique (an EU forum for European scientific research co-operation.)
CZM Coastal Zone Management
DANI Department of Agriculture for Northern Ireland
DETR Department of Environment Transport and the Regions (DoE until mid 1997)
DML 1) Dove Marine Laboratory, Cullercoats
2) Dunstaffnage Marine Laboratory, Oban
DoE Department of the Environment (DETR after mid 1997)
DoE(NI) Department of the Environment for Northern Ireland
DTI Department of Trade and Industry
EA 1) Environmental Assessment
2) Environment Agency
EC 1) European Commission; the Commission of the European Communities;
2) European Community (now referred to as the European Union)
EcoQ Ecological Quality
EEA European Environment Agency
EIA Environmental Impact Assessment or Analysis
EIR Environmental Information Regulations
EIS Environmental Impact Statement
EMS European Marine Site
EN English Nature
ENSIS English Nature SSSI Information System
ERA Environmental Risk Assessment
ES Environmental Statement
ESA Environmentally Sensitive Area
ESI Environmental Sensitivity Index
EcoQO Ecological Quality Objective
EQO Environmental Quality Objective
EU European Union
EUCC European Union for Coastal Conservation
FSC Field Studies Council
FSCRC Field Studies Council Research Centre
GB Great Britain
GESAMP Joint Group of Experts on the Scientific Aspects of Marine environmental
Protection (until about 1991, the Joint Group of Experts on the Scientific Aspects of Marine Pollution) (an advisory body to the Heads of eight organisations of the United Nations System)
GIS Geographical Information System
GOOS Global Ocean Observing System
IAMW Important Area for Marine Wildlife
ICES International Council for the Exploration of the Sea
ICZM Integrated Coastal Zone Management
IFREMER Institut Français de Recherché pour l’Exploitation de la Mer
IMA Important Marine Area
IMO International Maritime Organisation
IOE Institute of Offshore Engineering (Heriot Watt University, Edinburgh)
IUCN International Union for the Conservation of Nature and Natural Resources
JAMP Joint Assessment and Monitoring Programme (OSPAR)
JNCC Joint Nature Conservation Committee
LIFE L’Instrument Financier pour l’Environnement [Financial Instrument for the Environment]
LME Large Marine Ecosystem
LNR Local Nature Reserve
MarLIN Marine Life Information Network
MAFF Ministry of Agriculture, Fisheries and Food
MBA Marine Biological Association of the United Kingdom
MNA Maritime Natural Area
MARPOL International Convention for the Prevention of Pollution of the Sea from Ships
MARS Network of European Marine Research Stations
MBA Marine Biological Association of the United Kingdom
MCA 1) Marine Consultation Area, or
2) (generally prefixed ‘Voluntary’) Marine Conservation Area
MCS Marine Conservation Society
MEHRA Marine Environmental High-Risk Area
MNCR Marine Nature Conservation Review
MN Marine Nature Reserve
MPA Marine Protected Area (generic term)
NCC Nature Conservancy Council
NCCE Nature Conservancy Council for England (English Nature; NCCE remains the formal legal title)
NERC Natural Environment Research Council
NGO non-governmental organisation
NHM The Natural History Museum, London
NMMP National Marine Monitoring Plan (UK)
NNR National Nature Reserve
NP National Park (England and Wales)
NRA National Rivers Authority (now the Environment agency)
NRSC National Remote Sensing Centre
NSQSR North Sea Quality Status Report
NSTF North Sea Task Force
NT National Trust
NTS National Trust for Scotland
NVZ Nitrate Vulnerable Zone
OLD Operations Likely to Damage (English Nature term)
OPRU Oil Pollution Research Unit
OSIS Oil Spill Information System
OSPAR OSlo/PARis Convention (short title for the 1992 International Convention for the Protection of the Marine Environment of the North-East Atlantic)
OSPARCOM OSlo and PARis COMmissions
PCBs poly-chlorinated biphenyls
PCoA Principal Co-ordinates Analysis
PDA potentially damaging activity (generally used in context of marine protected areas)
PDO potentially damaging operation (generally used in context of notified SSSIs)
PML Plymouth Marine Laboratory (of NERC)
PPG Planning Policy Guidance note
ppt parts per thousand (measurement of salinity, normally expressed as ‰)
PRIMER Plymouth Routines In Multi-variate Ecological Research (a multivariate analytical programme)
PSP paralytic shellfish poisoning
PSSA Particularly Sensitive Sea Area
QSR Quality Status Report
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUASIMEME</td>
<td>QUality ASsurance of Information for Marine Environmental Monitoring in Europe</td>
</tr>
<tr>
<td>RDB</td>
<td>Red Data Book</td>
</tr>
<tr>
<td>redox</td>
<td>REDuction-OXidation</td>
</tr>
<tr>
<td>RoxAnn</td>
<td>Reputedly a derivation from &quot;rocks and sand&quot;; see glossary of terms</td>
</tr>
<tr>
<td>RSPB</td>
<td>Royal Society for the Protection of Birds</td>
</tr>
<tr>
<td>SAC</td>
<td>Special Area of Conservation</td>
</tr>
<tr>
<td>SACFOR</td>
<td>An abundance scale used by MNCR for recording benthic marine organisms (see Hiscock 1996): Superabundant; Abundant; Common; Frequent; Occasional; Rare</td>
</tr>
<tr>
<td>SAMs</td>
<td>Scottish Association for Marine Science</td>
</tr>
<tr>
<td>SAST</td>
<td>Seabirds at Sea Team (a project within JNCC’s Seabirds and Cetaceans Branch)</td>
</tr>
<tr>
<td>SCOPAC</td>
<td>Standing Conference on Problems Associated with the Coastline</td>
</tr>
<tr>
<td>SCR</td>
<td>Seabird Colony Register (JNCC)</td>
</tr>
<tr>
<td>Seasearch</td>
<td>A JNCC &amp; MCS Phase 1 sublittoral habitat survey</td>
</tr>
<tr>
<td>SEPA</td>
<td>Scottish Environment Protection Agency</td>
</tr>
<tr>
<td>SERCON</td>
<td>System for Evaluating Rivers for CONservation</td>
</tr>
<tr>
<td>SMA</td>
<td>Sensitive Marine Area</td>
</tr>
<tr>
<td>SMBA</td>
<td>Scottish Marine Biological Association (now Scottish Association for Marine Science)</td>
</tr>
<tr>
<td>SNH</td>
<td>Scottish Natural Heritage</td>
</tr>
<tr>
<td>SNIFFER</td>
<td>Scotland and Northern Ireland Forum for Environmental Research</td>
</tr>
<tr>
<td>SPA</td>
<td>Special Protection Area (a site designation under the 1979 EC Directive on the Conservation of Wild Birds)</td>
</tr>
<tr>
<td>SQM</td>
<td>Site Quality Monitoring</td>
</tr>
<tr>
<td>SSSI</td>
<td>Site of Special Scientific Interest</td>
</tr>
<tr>
<td>SWQO</td>
<td>Statutory Water Quality Objective</td>
</tr>
<tr>
<td>SWT</td>
<td>Scottish Wildlife Trust</td>
</tr>
<tr>
<td>TBT</td>
<td>tri-butyl tin (organotin)</td>
</tr>
<tr>
<td>TWINSPAN</td>
<td>Two-Way INdicator SPecies ANalysis (a multivariate analytical programme)</td>
</tr>
<tr>
<td>UCNW</td>
<td>University College of North Wales (now known as University of Wales, Bangor)</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>UKDMAP</td>
<td>United Kingdom Digital Marine Atlas Project</td>
</tr>
<tr>
<td>UKOOA</td>
<td>United Kingdom Offshore Operators’ Association</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
</tr>
<tr>
<td>VCO</td>
<td>Voluntary Conservation Organisation</td>
</tr>
<tr>
<td>VSA</td>
<td>Very Sensitive Area (normally used in context of fish-farming)</td>
</tr>
<tr>
<td>WA</td>
<td>(as suffix, e.g. SWWA) Water Authority</td>
</tr>
<tr>
<td>WWF</td>
<td>World-Wide Fund for Nature (formerly World Wildlife Fund)</td>
</tr>
<tr>
<td>ZNIEFF</td>
<td>Zones Naturelles d’Intérêt Écologique, Faunistique et Floristique [Natural Zones of Ecological, Faunistic or Floristic Interest] (A French initiative to identify sites of interest and classify biotopes.)</td>
</tr>
</tbody>
</table>
Appendix 4. Catalogue of recent or current methods of identifying and/or quantifying sensitivity and an assessment of their strengths and weaknesses.

<table>
<thead>
<tr>
<th>Description of system and references</th>
<th>Strengths</th>
<th>Weaknesses</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson, S. and Moore, J. 1997. Guidance on assessment of seabed wildlife sensitivity for marine oil and gas exploration. A report to JNCC from OPRU, Neyland, UK. Report No. OPRU/18/96. A scale of 1-4 is applied on a matrix of habitats against potential consequences (effects) of oil exploration. For each consequence, a total score is produced and multiplied by a weighting factor of 5, 2 or 1 depending on the likelihood of the consequence occurring to give an overall weighted score. The approach takes account of likelihood of a factor occurring. Practical experience of likely effects of a wide range of factors likely to occur during oil exploration was used including some workshop material. The matrix is simple to understand.</td>
<td>A key to the 4-point scale could not be found so that it is very subjective. By using a ‘1’ as the lowest score (which presumably means no or little effect likely), summing a column of 1’s and then multiplying by 5 (if the factor is highly likely to occur), a very high score is achieved even though impact is likely to be negligible or nil.</td>
<td>Based partly on the methodology from Holt et al. (1995) but only in relation to effects of oil and gas exploration.</td>
<td></td>
</tr>
<tr>
<td>Cooke, A. and McMath, M. 1998. SENSMAP: Development of a protocol for assessing and mapping the sensitivity of marine species and benthos to maritime activities. CCW Marine Report:98/6/1 Development of the method used by MacDonald et al.</td>
<td>Can deal with non-linear effects and effects of multiple factors. Includes confidence values. Refers to ‘Species intolerance’ as a measure of the inability of a species to endure damage caused by an external</td>
<td>Recoverability is integral to sensitivity. Vulnerability not yet included. Even though the system uses an objective formula, allocating scores in the first place is subjective. Use of a formula may mean that oversimplification of</td>
<td>Intolerance is ranked on a scale of 0-10. Recoverability is assessed using three categories scored on 1-4 scale. Intolerance measured by % of population killed or</td>
</tr>
</tbody>
</table>
(1996). Use a formula of

\[ S = I \times R^2 \]

Where \( S \) = sensitivity, \( I \) = intolerance and \( R \) = recoverability

Recoverability and intolerance values will exist on a database and then when species and effect information are put in the resulting sensitivity will be the output.


A simple 1-10 scale primarily depending on physical characteristics of the shoreline


6 point scales used.
| Holt, T.J., Jones, D. R., Hawkins, S.J. & Hartnoll, R.G. (1995, 1997). The sensitivity of marine communities to man-induced change. (1995 Report No. 65 for CCW, 1997 Irish Sea Forum) | Scoring of life forms provides a compromise between resolution and practicality. ‘Damage’ and recoverability treated separately. Allows variable weighting. Very useful as a source of information on effect of impacts such as oil, general chemicals and temperature. Also identifies factors most important to habitat types and biotope complexes. | Compromised by a requirement to assess sensitivity against ‘life forms’ and, partly because of the coarseness of such a classification, they found that none of the life forms was particularly sensitive. ‘Life forms’ not readily applied to many situations. No inclusion of vulnerability. Over-simplification of definitions used in scoring inevitable. Problems reconciling inter-relationships between categories –Provides only an all-round sensitivity rating. No discussion of the importance of individual species in determining sensitivity within life forms or communities. | Lack of discrimination may be improved by using a scale that starts at zero. Could be applied to a variety of detrimental effects. |
| Macdonald , D.S., Little, N., Eno, C., & Hiscock, K. 1996. Disturbance of benthic species by fishing activities: a sensitivity index. *Aquatic Conservation, 6:* 257-268. | The approach provides a structured integration of the main factors determining likely sensitivity and is an improvement on complete subjectivity. Convenient single score for comparisons. Quite good for the effects of fishing which can be easily categorised. | The three variables in the equation are subjective and different scores might be given by different workers. Also, raising the recoverability score to the power of e is a crude way of weighting. Based on the assumption that the disturbance has a linear effect on sensitivity. Doesn’t separate sensitivity and recoverability – fixed weighting for recoverability. Limited to single species, single factor, single event. Use of formula may mean that oversimplification of definitions occurs. | MacDonald *et al.* (1996) were able to identify a small number of species likely to be highly sensitive to certain types of fishing gear. |
*I* is the intensity of the *impact* (scored on an arbitrary scale of 1 to 3, equivalent to low, moderate and high intensity).

<table>
<thead>
<tr>
<th>OSPAR Workshop on species and habitats. Texel. February 24-28 1997. Identified example habitats and species and their ‘importance’ in terms of ‘Ecological value’ and ‘Status’ including sensitivity/ poor recoverability which was scored as ‘Local effect’, ‘sensitive’, ‘Very sensitive’.</th>
<th>Expert European group.</th>
<th>Sensitivity/ recoverability was a small part of the work of the group. The scoring system for sensitivity was restricted in extent. <strong>‘Very sensitive’ =</strong> if adversely affected by human activities will only recover over a long period (.25 years). <strong>‘Sensitive’ species =</strong> will only recover in 5-25 years.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Michel, J., &amp; Dahlin, J. 1993. Guidelines for developing digital environmental sensitivity index atlases and databases.</strong> Research Planning Inc. 1998. Environmental Sensitivity Index (ESI). <a href="Http://www.Researchplanning.com/esi/esi.htm">Http://www.Researchplanning.com/esi/esi.htm</a></td>
<td>Widely used in the USA and the approach is used world-wide. Therefore must be considered practical and authoritative. Includes some subtidal aspects. The map-based approach is easily used and rapidly available in the event of an accident.</td>
<td>Restricted to oil spill effects on the shore, sea surface and shallow subtidal (although ‘interest’ features are relevant to any adverse activity). Likelihood of damage to biological resources and potential for recovery potential not obvious from material inspected. No clear scoring system for sensitivity or recoverability of any individual biotopes or species.</td>
</tr>
</tbody>
</table>
| Designed for the impact of oil spills. Sensitivity ranking is based on:  
• Relative exposure to wave and tidal energy.  
• Shoreline slope.  
• Substrate type.  
• Biological productivity and sensitivity.  
The ESI scale is 1 (Exposed impermeable vertical substrates) to 10 (vegetated wetlands). | | |

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| Weslawski, J.M., Wiktor, J., Zajaczkowski, M., Futsaeter, G. and Moe, K.A. 1997. Vulnerability assessment of Svalbard intertidal zone for oil spills. *Estuarine, Coastal and Shelf Science*. 44 (Supplement A) 33-41. Provides a system for estimating a coast's vulnerability to oil spills. Considers both physical and biological parameters. Up to 19 factors considered. | Simple, easy allocation of scores to both biological and physical factors. Clear descriptions of factors. Worst case scenario approach used for squares with special features. Capacity to deal with varied habitats within a square. Only deals with 5x5 Km squares. Problems associated with transforming point data into 25km² If different habitats occur within a square then a compromise has to be reached as to the score allocated. Biological and physical vulnerabilities scored independently. No seasonal aspect. Scoring bands for physical and biological vulnerability are different. Only deals with intertidal effects. Factors ranked by importance (principal, important and secondary). For each factor three vulnerabilities were identified; low (1) medium (2) and high (3) To calculate a score the factor was multiplied by the vulnerability value. Factors were weighted as follows principal (6), important (3) and secondary (1).The mean values for each factor category are summed. Scores are divided into four bands |
Appendix 5. Key information review as a background to Species Action Plans (UK Biodiversity Action Plans)

KEY INFORMATION ON: Eunicella verrucosa

[This example uses a previous 5-level scale for sensitivity assessment]

AUTHOR: Keith Hiscock

1. Information from the Species Directory (with added common names):

   Phylum: Cnidaria  
   Class: Hexacorallia  
   Subclass: 
   Order: Gorgonacea  
   Family: Plexauridae  
   Genus: Eunicella  
   Species & authority: verrucosa (Pallas 1766)  
   Subspecies / variety / form:  
   Recent synonyms:  
   Common name(s): Pink sea fan

2. Key identification features:

   Colonies are profusely branching usually in one plane creating a fan-shaped colony. The colonies may be up to 30 cm high and/or broad. The polyps are close-set and irregularly arranged on the branches giving a knobbly appearance. The colour is almost always salmon pink in British colonies but white becomes the predominant colour with increasing distance south along the coast of continental Europe. Irish colonies are also white. The living coenencycme coats a black or dark brown axis. Microscopic inspection of the spicules may be needed to confirm identification. (Based on Manuel 1988.)

3. Recorded distribution

   Britain & Ireland: Extending eastwards to Lyme Bay and probably to Portland Bill in the English Channel but recorded almost to the Thames Estuary at Margate in historical times (Manual 1988). To the north and east, recorded eastwards in the Bristol Channel from North Devon near Ilfracombe where it was present in the 1970's (K. Hiscock, own observations) but on the north shores of the Bristol Channel known only from the entrance at Skomer. The northwards distribution in the Irish Sea is to at least to north Pembrokeshire but specimens have been reported to have been caught by fishermen off Bardsey (R. Holt, pers. comm.). Occurs all along the west coast of Ireland to Northern Ireland and may occur in Scotland (Manual 1988).

   NE Atlantic: Recorded south to north-west Africa including sparse records from the Canary Isles and extensively present in the Mediterranean (Carpine & Grasshoff 1975).

   World: Western basin of the Mediterranean, north-west Africa and mainland coast of the north-east Atlantic north to south-west Britain.

4. Biotopes found in (* = characteristic of the biotope): Alcyonium digitatum with massive sponges (Cliona celata and Pachymatisma johnstoni) and Nemertesia antennina on moderately tide-swept exposed circlitlitoral rock (ECR.AlcMaS) (usually in local shelter); Phakellia ventilabrum and axinellid sponges on deep exposed circlitlitoral rock (MCR.PhaAxi); Erect sponges, Eunicella verrucosa and Pentapora foliacea on slightly tide-swept moderately exposed circlitlitoral rock (MCR.ErSEun)*; Cushion sponges (Polymastia boletiformis, Tethya), branching sponges, Nemertesia spp. and Pentapora foliacea on moderately exposed circlitlitoral rock (MCR.ErSPbolSH).

5. Other information (complete from initial review then opportunistically): Studies at Ilfracombe, Lundy and Skomer have shown that the branches of colonies grow at irregular rates but an approximate mean of 10 mm a year. This suggests that the larger colonies are 30 or more years old. Recruitment
appears to be irregular but sufficiently frequent to maintain dense populations at some locations. The axis has annual growth rings which suggest slower growth in cold years (K. Hiscock, unpublished).

Photographs: [source and reference number]

Habitat found in:

<table>
<thead>
<tr>
<th>Physiographic</th>
<th>Open coast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substratum</td>
<td>Bedrock or stable boulders</td>
</tr>
<tr>
<td>Wave exposure</td>
<td>Very exposed to Sheltered.</td>
</tr>
<tr>
<td>Tidal stream strength</td>
<td>Moderately strong to weak.</td>
</tr>
<tr>
<td>Height/Depth (as zone)</td>
<td>Lower Infralittoral, Circalittoral.</td>
</tr>
<tr>
<td>Salinity</td>
<td>Full.</td>
</tr>
<tr>
<td>Other</td>
<td>On upward facing rock.</td>
</tr>
</tbody>
</table>

Description of habitat preferences: Present on upward facing rock in the lower infralittoral but especially the circalittoral where it may form forests in favourable conditions. Present to 200m depth (Manuel 1988). Thrives most on exposed coasts but below the zone of multidirectional water movement (below about 25m on coasts exposed to prevailing winds and oceanic swell) and where there are moderately strong tidal streams.

Origin (non-native species): n/a

Date of arrival in UK (non-native species): n/a

Sensitivity (of adults) [Score as: 5 = minor impact/concentration/variation from normal in a single brief event would cause mortality; 4 = minor impact/concentration/variation from normal in a prolonged or multiple event would cause mortality; 3 = considerable force/concentration/variation from normal or prolonged or several events required to cause mortality; 2 = force of impact would have to be ‘crushing’ or prolonged/concentration high and long-term/variation from normal would be required to cause long-term to cause mortality; 1 = resilient, most likely because of ability to avoid the potentially damaging event (migration, close-up, bury) at least in the short term (hours or a few days); 0 = no damage likely even from major physical force or concentrated contaminant over a sustained period (several days) - either extremely tough or able to remain out of the impacting activity - for instance, by being buried or swimming away].

| Physical impact (fragility) | 3 |
| Physical disturbance (displacement) | 5 |
| Siltation                    | 2 |
| Turbidity                    | 3 |
| Deoxygenation                 | 4 |
| Salinity change               | 4 |
| Temperature change            | 3 |
| Oil pollution                 | 3 |
| Chemical contaminants         | 3 |
| Eutrophication                | 2 |
| Other (name)                  |  |

Recovery potential (in relation to a single event causing mortality) [Score as 5=Very poor, even partial recovery unlikely at the location for at least 25 years; 4=Poor, partial recovery likely within 10 years, full recovery likely to take up to 25 years; 3=Moderate, partial recovery likely within 5 years, full recovery likely to take up to 10 years; 2=High, full recovery will occur but will take at least several months; 1=Very high, full recovery likely within a few weeks or at most 6 months; 0=recovery immediate or within a few days).]

= 4
**Feeding type:** Carnivore

**Life-span:** [Score as: 5=possibly over 100 years; 4=several decades; 3=<10 years; 2=<5 years; 1=annual or <1 year]

= 4

**Reproduction:**

- Asexual (budding, splitting)
- Planktonic larva - long
- Planktonic larva - short
- Benthic larva
- live-bearer - parental care
- live-bearer - no parental care
- egg-layer - parental care
- egg-layer - no parental care

**Time of year reproduction occurs:** Not known.

**Frequency of reproduction:** Not known but lack of small individuals in most years suggests that reproduction and settlement may occur only every few years.

**Age at which sexual maturity reached:** Not known.

**Growth rate:** About 1 cm in branch length per year. Likely to be more in south-west England and less at the eastern and northern limits of distribution.

**Key references:**

- Biology Carpine & Grasshoff (1975).
- Effects of human activities Eno et al. (1996).
- Fluctuations in abundance

**Historical information (eg past losses/gains, changes in distribution):** May once have occurred as far east in the English Channel as Margate (Manuel 1988).

**Parasite on/in:** n/a

**Symbiont on/in:** n/a

**Inquilinist on/in:** n/a

**Host for:** The sea anemone *Amphianthus dohrnii*; the sea slug *Tritonia nilsohdneri*; the prosobranch *Simnia patula*. Other species attach to branches especially ephemeral algae (in shallow depths) and branching bryozoans. Squid attach their eggs to branches.

**Considered key-stone?** Yes

**Why keystone?:**

- Feeds on others (population control)
- Fed on by others (food chain link)
- Habitat for community

**Keystone species in which biotopes:** ECR.AlcMaS, MCR.PhaAxi, MCR.ErSEun, MCR.ErSPbolSH.
### Applications / use:

<table>
<thead>
<tr>
<th>Category</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade</td>
<td>no</td>
</tr>
<tr>
<td>Aquaculture</td>
<td>no</td>
</tr>
<tr>
<td>Harvest</td>
<td>no</td>
</tr>
<tr>
<td>Curiosity / charisma (tourism)</td>
<td>minor</td>
</tr>
<tr>
<td>Research</td>
<td>minor</td>
</tr>
<tr>
<td>Culinary</td>
<td>no</td>
</tr>
</tbody>
</table>

### Protected status or relevance under Conventions and Directives:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berne</td>
<td>no</td>
</tr>
<tr>
<td>CITES</td>
<td>no</td>
</tr>
<tr>
<td>EC Habitats Directive</td>
<td>no</td>
</tr>
<tr>
<td>W&amp;C 1981 Act</td>
<td>yes</td>
</tr>
<tr>
<td>NI ACT</td>
<td>no</td>
</tr>
<tr>
<td>UK Biodiversity Action Plans</td>
<td>yes</td>
</tr>
<tr>
<td>Other (name)</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 6. Key information review as background to the OSPAR IMPACT meeting in September 1998

Compiled by: Keith Hiscock, English Nature, Northminster House, Peterborough PE1 1UA. UK.

[This example uses a previous 5-level scale for sensitivity assessment]

Derived, in part, from: the UK marine biotope classification (Connor et al. 1997(b)) and a review undertaken for the UK Marine SACs Project (Davison 1998).

Classification

<table>
<thead>
<tr>
<th>Classification</th>
<th>Code</th>
<th>Biotope(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wadden Sea (1996)</td>
<td>03.02.05</td>
<td>Benthic zone of the shallow coastal waters with muddy and sandy bottom, rich in macrophytes</td>
</tr>
<tr>
<td>UK (MNCR BioMar – 97.06)</td>
<td>IMS.Zmar</td>
<td>Zostera marina/angustifolia beds in lower shore or infralittoral clean or muddy sand</td>
</tr>
<tr>
<td>France (ZNIEFF-MER)</td>
<td>II.3.3</td>
<td>Herbiers de Zostera marina, Zostera noltii (= Z. nana pro parte) du médialittoral inférieur</td>
</tr>
<tr>
<td></td>
<td>III.3.4</td>
<td>Herbiers de Zostera marina</td>
</tr>
</tbody>
</table>

Description

**IMS.Zmar.** Expanses of clean or muddy fine sand in shallow water and on the lower shore (typically to about 5 m depth) can have dense stands of *Zostera marina/angustifolia* [Note: the taxonomic status of *Z. angustifolia* is currently under consideration but is most likely a dwarf form of *Zostera marina*]. In IMS.Zmar the community composition may be dominated by these *Zostera* species and therefore characterised by the associated biota. Other biota present can be closely related to that of areas of sediment not containing *Zostera marina*, for example, *Laminaria saccharina, Chorda filum* and infaunal species such as *Ensis* spp. and *Echinocardium cordatum* (e.g. Bamber 1993) and other bivalves listed below. It should be noted that sparse beds of *Zostera marina* may be more readily characterised by their infaunal community. Beds of this biotope in the south-west of Britain may contain conspicuous and distinctive assemblages of Lusitanian fauna such as *Laomedea angulata, Hippocampus* spp. and Stauromedusae. Some examples of *Zostera marina* beds have markedly anoxic sediments associated with them. (from Connor et al. 1997(b))

Distribution
Habitat requirements

<table>
<thead>
<tr>
<th>Habitat factor</th>
<th>Range of conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Salinity</strong></td>
<td>Fully marine; Variable; Reduced; Low. McRoy (1966) suggests optimum salinities of 10 to 39‰, den Hartog (1970) reports tolerances as low as 5‰ in the Baltic. Laboratory studies indicate that maximum germination occurs at 30°C and 1‰ salinity (Hootsmans et al. 1987). Field studies indicate that germination occurs over a wide range of temperatures and salinities (Churchill 1983, Hootsmans et al. 1987). In brackish waters along the Atlantic coast, Zostera marina behaves as an annual plant, shedding its leaves in winter (Jacobs 1982). Low salinities may encourage production of reproductive shoots and stimulate leaf production. Zostera marina beds survived disease especially in low salinity conditions in the eastern United States (Muehlstein, Porter &amp; Short 1988).</td>
</tr>
<tr>
<td>Wave exposure</td>
<td>Sheltered, Very sheltered, Extremely sheltered, Ultra sheltered</td>
</tr>
<tr>
<td>Tidal streams</td>
<td>Weak, very weak</td>
</tr>
<tr>
<td>Substratum</td>
<td>Clean sand, muddy fine sand, mud</td>
</tr>
<tr>
<td>Zone</td>
<td>Lower shore, Upper infralittoral</td>
</tr>
<tr>
<td>Depth range</td>
<td>0-5 m</td>
</tr>
<tr>
<td>Temperature</td>
<td>Optimum temperature range for Zostera marina appears to be between 5 and 30 °C (Marsh et al. 1986, Bulthius 1987). Seasonal growth is closely associated with temperature. Yonge (1949) suggested that growth ceases below 10 °C and that flowers could only open and seeds form when the temperature exceeded 15 °C. Zostera marina beds which occur intertidally may be damaged by frost although the rhizomes most likely survive (Covey &amp; Hocking 1987).</td>
</tr>
<tr>
<td>Water quality</td>
<td>Zostera marina requires high light levels. It most commonly occurs shallower than 2m below chart datum, exceptionally to 5m and the deepest recorded depth it has been found in Britain and Ireland is 13m below chart datum off south-west Ireland (Cullinane et al. 1985). Harrison (1987) describes how the extent of a Zostera marina bed expanded after construction of a causeway blocked the flow of silty water.</td>
</tr>
<tr>
<td>Nutrients</td>
<td>It seems most likely that nitrogen is the limiting nutrient. In carbonate-based sediments, phosphates may be limiting due to adsorption onto sediment particles (Short 1987). Mild nutrient enrichment of sediments may stimulate growth of Zostera marina shoots (Roberts et al. 1984).</td>
</tr>
</tbody>
</table>

(from Connor et al. 1997b, unless otherwise stated)

Species composition and biodiversity

Characterising species

<table>
<thead>
<tr>
<th>For IMS.Zmar in the UK</th>
<th>% Frequency</th>
<th>Faithfulness</th>
<th>Typical abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemonia viridis</td>
<td>⬤ ⬤</td>
<td>⬤</td>
<td>Frequent</td>
</tr>
<tr>
<td>Arenicola marina</td>
<td>⬤ ⬤</td>
<td>⬤</td>
<td>Occasional</td>
</tr>
<tr>
<td>Lanice conchilega</td>
<td>⬤ ⬤</td>
<td>⬤</td>
<td>Occasional</td>
</tr>
<tr>
<td>Pagurus bernhardus</td>
<td>⬤ ⬤</td>
<td>⬤</td>
<td>Occasional</td>
</tr>
<tr>
<td>Carcinus maenas</td>
<td>⬤ ⬤ ⬤ ⬤</td>
<td>⬤</td>
<td>Occasional</td>
</tr>
<tr>
<td>Gibbula cineraria</td>
<td>⬤ ⬤</td>
<td>⬤</td>
<td>Occasional</td>
</tr>
<tr>
<td>Hinia reticulata</td>
<td>⬤ ⬤ ⬤ ⬤</td>
<td>⬤</td>
<td>Occasional</td>
</tr>
<tr>
<td>Chorda filum</td>
<td>⬤ ⬤</td>
<td>⬤</td>
<td>Frequent</td>
</tr>
<tr>
<td>Laminaria saccharina</td>
<td>⬤ ⬤</td>
<td>⬤</td>
<td>Occasional</td>
</tr>
<tr>
<td>Ulva sp.</td>
<td>⬤ ⬤</td>
<td>⬤</td>
<td>Frequent</td>
</tr>
<tr>
<td>Zostera marina</td>
<td>⬤ ⬤ ⬤ ⬤ ⬤ ⬤</td>
<td>⬤</td>
<td>Abundant</td>
</tr>
</tbody>
</table>

(from Connor et al. 1997b)
Species found uniquely in biotope

The hydroid Laomedia angulata and the algae Rhodophysema georgii, Halothrix lumbricalis, Leblondiella densa, Myrionema magnusii, Cladosiphon zosterae and Punctaria crispata have only been recorded attached to seagrass leaves. The endophytic green alga Entocladia perforans is also host specific to Zostera marina.

Number of species recorded in biotope

Ecological relationships

Zostera marina provides a habitat for a wide range of species to find shelter or a suitable substratum on which to live. Fish occur amongst the seagrass and include the wrasse and goby species also found in kelp. The green wrasse (Labrus turdus) is normally associated with seagrass beds in the Mediterranean and may be present in Isles of Scilly Zostera marina beds (Fowler 1992). Especially found in sea grass beds are pipe fish Syngnathus typhle and Entelurus aequoraesus and, rarely, sea horses Hippocampus ramulosus. Cuttlefish, Sepia officinalis, are also found and lay their eggs amongst seagrass. Small prosobranchs, especially Rissoa sp(p) and Lacuna vincta graze on the leaves. The mud snail Hydrobia ulvae is found on leaves in estuarine conditions. At open coast sites, stauromedusae (stalked jellyfish), Haliclystus auricula and Lucernarioopsis campanulata, may be present on leaves. The hydroid Laomedia angulata and the algae Rhodophysema georgii, Halothrix lumbricalis, Leblondiella densa, Myrionema magnusii, Cladosiphon zosterae and Punctaria crispata have only been recorded attached to seagrass leaves. The endophytic green alga Entocladia perforans is also host specific to Zostera marina. Seagrass rhizomes help to stabilise sediments and may thereby increase species diversity. Sea anemones (Cereus pedunculatus, Cerianthus lloydii) and the prosobranch Nassarius reticulatus are often common in the sediment. In the Isles of Scilly, the sea anemone Anthopleura ballii is unusually present.

Habitat complexity

Seagrasses provide shelter and hiding places. The leaves and rhizomes provide substrata for the settlement of epibenthic species which in-turn may be grazed upon by other species.

Recruitment processes

Zostera marina provides refuges for many species of fish and nursery areas for some.

Sediment stabilisation

The slowing of water movement by leaves encourages accumulation of sediments whilst the dense rhizome and root system stabilises the sediment preventing or reducing sediment loss. The consolidation of the sediments enables the development of richer infaunal communities with higher densities of individuals than those in adjacent bare sediments (reviewed most recently in Boström & Bonsdorff (1997).

Productivity

Sea grasses have high rates of primary production and are an important source of organic matter whose decomposition provides a starting-point for detritus-based food chains. They also provide a substratum for other plant species.

Keystone (structuring) species

Zostera marina, Labrynthula macrocystis

Importance of biotope for other species

Intertidal and probably shallow subtidal Zostera marina beds provide a source of food for a variety of wildfowl, although not to the extent that intertidal Zostera noltii do. Studies of feeding on Zostera rarely differentiate which species is being referred to. Tubbs & Tubbs (1983) reported that brent geese grazing contributed to the cover of Zostera marina and Zostera noltii being reduced from between 60-100% cover in September to between 5-10% cover between mid-October and mid-January. The observation (den Hartog 1977) that the decline in Zostera marina during the wasting disease of the 1930’s was followed by very heavy losses of the Brent goose and the Canada goose suggests that they rely on Zostera marina for a
large proportion of their food. However, it remains unclear and seems unlikely that subtidal *Zostera marina* beds are affected by wildfowl grazing.

Although much referred to as a nursery area for fish, there is little evidence to support the assertion that beds of *Zostera marina* provide such a facility.

**Temporal changes**

*Zostera marina* beds are naturally dynamic, at least in open coastal areas. In the Isles of Scilly, beds have ‘advancing’ and ‘receding’ edges. The fungus *Labyrinthula macrocystis* caused the loss of over 90% of *Zostera marina* beds in the 1920’s and 1930’s and a full recovery has not yet occurred (Vergeer *et al.* 1995 for a recent review). *Zostera marina* beds may show marked annual changes. In brackish conditions, there is die-back of the leaves in the autumn and regrowth in the spring and early summer (Jacobs 1982, Dyrynda 1997). This die-back has been observed to be almost complete in The Fleet in Dorset, UK (Dyrynda 1997) and resulted in sediment destabilisation as well as loss of cover for fish and substratum for invertebrates.

**Time for community to reach maturity**

*Zostera marina* beds most likely do not seed and establish rapidly. There has been little recovery of *Zostera marina* beds following the wasting disease in the 1930’s. Olesen & Sand-Jensen (1994) reported that, in Danish waters, new *Zostera marina* beds could take at least five years to become established and stable with small patches (<32 shoots) showing high mortalities. However, these observations are near to established beds and seeding over a distance particularly between isolated water bodies is likely to be slow. An extensive series of experiments has been undertaken to try to re-establish beds (see, for instance, Fonesca *et al.* 1994).

**Sensitivity to human activities**

<table>
<thead>
<tr>
<th>Sensitivity to:</th>
<th>Human activity</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impact (fragility)</td>
<td>Mobile (bottom) fishing gear</td>
<td>2</td>
<td>Seagrass is flexible and likely to be resilient to impact</td>
</tr>
<tr>
<td></td>
<td>Shipping – anchoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical disturbance (displacement)</td>
<td>Dredging (navigation channel maintenance)</td>
<td>3</td>
<td>Displacement may happen as a result of anchors being dragged through a seagrass bed or over-vigorous foraging by wildfowl. The most frequent and probably severe effect is from storms. Severe or prolonged storm events may cause significant losses. Floods in estuarine situations may also increase water flows sufficiently to wash-out seagrasses or sediments (for instance, Wyre <em>et al.</em> 1977, DenHartog 1987).</td>
</tr>
<tr>
<td></td>
<td>Aggregate dredging</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maerl gravel and shell sand dredging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltation</td>
<td>Land claim</td>
<td>2</td>
<td>Siltation following normal events (for instance sediment taken into suspension by high river flows) is likely to be transitory and result in negligible impact.</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Spoil dumping</td>
<td>4</td>
<td>Prolonged increases in turbidity would reduce light penetration and prevent adequate photosynthesis by deeper populations of <em>Zostera marina</em>. Geisen <em>et al.</em> (1990) suggest that turbidity caused by eutrophication, deposit extraction and dredging activities were major factors in the decline of <em>Zostera</em> in the Wadden Sea.</td>
</tr>
<tr>
<td></td>
<td>Land drainage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deoxygenation</td>
<td>Salmonid fish farming</td>
<td>4</td>
<td>No evidence of effects found in the literature but de-oxygenation would be likely to adversely affect plants.</td>
</tr>
<tr>
<td>Factor</td>
<td>Impact</td>
<td>References</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Salinity change</td>
<td>Estuarine barrages</td>
<td>Zostera marina seems to be highly tolerant of changes in salinity. However a severe event such as replacement of seawater by a layer of freshwater after prolonged rain may have an effect.</td>
<td></td>
</tr>
<tr>
<td>Temperature change</td>
<td>Global warming</td>
<td>Den Hartog (1970) suggested that Zostera marina generally tolerates temperatures up to 20°C without showing signs of stress. There is likely to be damage through frost to beds exposed at low water (denHartog 1987).</td>
<td></td>
</tr>
<tr>
<td>Oil Pollution</td>
<td>Oil spills</td>
<td>Apparently healthy Zostera marina beds are known to exist in areas subject to low level chronic hydrocarbon contamination (see, for instance, Howard, Baker &amp; Hiscock 1989). Smothering by stranded oil is likely to occur on lower shore populations but little is known of effects [check Amoco Cadiz].</td>
<td></td>
</tr>
<tr>
<td>Contaminants</td>
<td>Inorganic mine and particulate wastes, Pesticides, Shipping (anti-fouling paints)</td>
<td>Terrestrial herbicides have been found to inhibit growth and cause decline in Zostera marina (Delistraty &amp; Hershner 1984) Some effects may be indirect. For instance, Zostera marina readily uptakes heavy metals and TBT (Williams et al. 1994). Whilst plants appeared unaffected, any loss of grazing prosobranchs due to TBT contamination in the leaves or externally would result in excessive algal fouling of leaves and poor productivity and possible smothering. Lead accumulation (from shotgun pellets) in sediments may stress Zostera plants.</td>
<td></td>
</tr>
<tr>
<td>Eutrophication</td>
<td>Sewage discharge</td>
<td>High nitrate concentrations have been implicated in the decline of Zostera marina by Burkholder et al. (1993). Such eutrophication may increase the cover of epiphytic algae and prevent photosynthesis of sea grass plants. Eutrophication may increase abundance of Labrifthula macrocystis (see below). However, nutrient enrichment may stimulate growth of Zostera marina (Fonesca et al. 1994)</td>
<td></td>
</tr>
<tr>
<td>Other (name)</td>
<td></td>
<td>Wasting disease. An infection by the fungus Labrinthula macrocystis which decimated Zostera marina in the 1920’s to the mid 1930’s. Continuously present at low levels; reason for epidemics unclear but stress including pollution incidents suggested (see, for instance, Rasmussen 1977, Short et al. 1988, Vergeer et al. 1995).</td>
<td></td>
</tr>
<tr>
<td>Wildfowl grazing</td>
<td></td>
<td>Wildfowl grazing</td>
<td></td>
</tr>
<tr>
<td>Mariculture</td>
<td>Shipping (As main causes of the importation of non-native species)</td>
<td>Exclusion by non-native species (esp. Sargassum muticum). Sargassum seems to colonise seagrass beds without displacing the seagrass. (For instance, Critchley 1983, Covey &amp; Hocking 1987). Future non-native species may be more ‘aggressive’ and have a greater affect.</td>
<td></td>
</tr>
</tbody>
</table>
Recovery potential

In relation to a single event causing mortality = 3
(Beds affected by chronic wasting disease could take longer.)

Assessment of regeneration ability in the Wadden Sea: B – Regeneration conditionally possible (less than 15 years) (Von Nordheim, Anderson & Thissen 1996)

Conservation, protection and management

Conservation status

<table>
<thead>
<tr>
<th>Region</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSPAR area</td>
<td>Not known</td>
</tr>
<tr>
<td>Wadden Sea</td>
<td>1 – Threatened by complete destruction (Von Nordheim, Anderson &amp; Thissen 1996)</td>
</tr>
<tr>
<td>UK</td>
<td>TBA</td>
</tr>
<tr>
<td>Other sub-regions</td>
<td>Not known</td>
</tr>
</tbody>
</table>

Protected status

<table>
<thead>
<tr>
<th>Protection mechanism</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC Habitats Directive</td>
<td>A named component of Lagoons (a priority habitat) and Shallow sandbanks slightly covered by seawater all of the time. Also a characteristic feature of Large shallow inlets and bays and Estuaries and occurs on the lower shore in Mudflats and sandflats not covered by the tide at low water.</td>
</tr>
<tr>
<td>UK Biodiversity Action Plan</td>
<td>Seagrass beds</td>
</tr>
</tbody>
</table>

Management measures

To maintain biotope in natural state: Avoid activities which result in increased levels of turbidity in the long term. Prevent excessive nutrification of water bodies.

To restore biotope to natural state: Remove or reduce sources of contaminants which may adversely affect associated grazing species. Minimise anchoring and prohibit the use of mooring chains, which drag the seabed in Zostera marina beds.
Appendix 7. Biology and sensitivity key information pro formas

Species Biology and Sensitivity Key Information Data Entry Fields

Revised Draft 2 September 1999

Scientific name (Authority and Date)
Common name(s)

TAXONOMY

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date first entered
5. MCS / Ulster Museum species code
6. Taxonomic classification
   Phylum
   Subphylum
   Superclass
   Class
   Subclass
   Order
   Suborder
   Family
   Subfamily
   Genus
   Species
   Subspecies / variety / form

7. English equivalent for Phylum
8. Recent synonyms (since 1950) with authorities and dates
9. General description
10. Key identification features
11. Images [with description, holder and photographer]
12. Additional information
13. Key references

GENERAL BIOLOGY (Larval)

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date first entered
5. Typical abundance in Britain
   High / Moderate / Low / Very low densities / Field not researched / No information found / Data deficient / Not relevant.

6. Typical body size range (units)
7. Mobility / Attachment
   Swimmer / Crawler / Burrower / Drifter / Temporary attachment / Permanent Attachment / Field not researched / No information found / Data deficient / Not relevant.

8. Sociability
   Solitary / Gregarious / Colonial / Field not researched / No information found / Data deficient / Not relevant.

9. Environmental position
   Epifaunal/floral / Infaunal / Interstitial / Demersal / Pelagic /
### Field not researched / No information found / Data deficient / Not relevant.

10. Growth form  
   See Appendix \textit{MarLIN} report No.1.

11. Body flexibility  
   High ( >45° ) / Low ( 10 – 45° ) / None (<10° )

12. Feeding method  
   Autotroph, Active/passive suspension, Surface/subsurface deposit, active/passive carnivore, active/passive omnivore, herbivore, scavenger, symbiont contribution, parasite, Field not researched / No information found / Data deficient / Not relevant.

13. Typically feeds on?
14. Is the species toxic?  
   Yes / No / Field not researched / No information found / Data deficient / Not relevant.

15. Further toxicity information

16. Mode of life – Dependent on  
   Independent, Parasite on/in, Mutualist on/in/with, Inquilinist on/in/with, Commensal on/in/with, Field not researched, No information found, Data deficient, Not relevant.

   Mode of life – Supports  
   Host for / Field not researched / No information found / Data deficient / Not relevant

17. Additional Information.
18. Key references

### GENERAL BIOLOGY (Adult)

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date first entered
5. Typical abundance in Britain  
   High / Moderate / Low / Very low densities / Field not researched / No information found / Data deficient / Not relevant.

6. Typical male and female body size range (units)
7. Male and female size at maturity (units)
8. Growth rate (units)
9. Mobility / Attachment  
   Swimmer / Crawler / Burrower / Drifter / Temporary attachment / Permanent Attachment / Field not researched / No information found / Data deficient / Not relevant.

10. Sociability  
   Solitary / Gregarious / Colonial / Field not researched / No information found / Data deficient / Not relevant.

11. Environmental position  
   Epifaunal/floral / Infaunal / Interstitial / Demersal / Pelagic / Field not researched / No information found / Data deficient / Not relevant

12. Growth form  
   See Appendix \textit{MarLIN} Report No. 1

13. Body flexibility  
   High ( >45° ) / Low ( 10 – 45° ) / None (<10° )

14. Feeding method  
   Autotroph, Active/passive suspension, Surface/subsurface deposit, active/passive carnivore, active/passive omnivore, herbivore, scavenger, symbiont contribution, parasite, Field not researched, No information found, Data deficient, Not relevant.

15. Typically feeds on?
16. Is the species toxic?  
   Yes / No / Field not researched / No information found / Data deficient / Not relevant.

17. Further toxicity information

18. Mode of life – Dependent on  
   Independent, Parasite on/in, Mutualist on/in/with, Inquilinist on/in/with; Commensal on/in/with; Field not researched / No
Mode of life – Supports

Host for; Field not researched / No information found / Data deficient / Not relevant.

19. Additional Information.

20. Key references

GEOGRAPHICAL DISTRIBUTION AND HABITAT PREFERENCES (larval)

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date first entered
5. Geographical Distribution Map and text description
6. Global distribution Map and text description
7. Habitat preferences
   Major
   Physiographic
   Biological zone
   Component
   Substratum
   Wave exposure
   Tidal stream strength
   Depth range in metres
   Salinity
   Other
8. Resident / Migratory
   Resident /non migratory, Seasonal feeding, Seasonal reproduction,
   Seasonal environmental, Diel, Passive, Active, Field not researched / No information found / Data deficient / Not relevant.
9. Additional information
10. Key references

GEOGRAPHICAL DISTRIBUTION AND HABITAT PREFERENCES (Adult)

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date first entered
5. Geographical distribution Map and text description
6. Global distribution Map and text description
7. Habitat preferences
   Major
   Physiographic
   Biological zone
   Component
   Substratum
   Wave exposure
   Tidal stream strength
   Depth range in metres
   Salinity
   Other
8. General habitat information
9. Resident / Migratory
   Resident /non migratory, Seasonal feeding, Seasonal reproduction,
Seasonal environmental, Diel, Passive, Active, Field not researched / No information found / Data deficient / Not relevant.

10. Native species Yes / No / Field not researched / No information found / Data deficient / Not relevant.

11. Origin if not native
12. Date of arrival if known
13. Additional information
14. Key references

REPRODUCTION

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date first entered
5. Life-span (units): <1 / 1-2 years / 2-5 years / 5-10 years / 10-20 years / 20-100 years /100+ years / Field not researched / No information found / Data deficient / Not relevant.

6. Age at maturity (units)
7. Generation time (units)
8. Reproductive type Budding, parthenogenesis, fission, Permanent hermaphrodite, Protandrous hermaphrodite, Protogynous hermaphrodite, Gonochoristic, Metagamic / Field not researched / No information found / Data deficient / Not relevant.


10. Fecundity (no. of eggs / young) 1 / 2-10 / 11-100 / 100 – 1,000 / 1,000 – 10,000 / 10,000 – 100,000 / 100,000 – 1,000,000 / 1,000,000+ / Field not researched / No information found / Data deficient / Not relevant.

11. Developmental mechanism Planktotrophic / Lecithotrophic / Direct Development / Ovoviviparous / Viviparous (Parental Care) / Viviparous (No Care) / Field not researched / No information found / Data deficient / Not relevant.

12. Larval settling time <1 day / 1 day / 2-10 days / 11-30 days / >30 days / Field not researched / No information found / Data deficient / Not relevant.

13. Dispersal potential <10m / 10-100m / 100-1000m / >1000m / Field not researched / No information found / Data deficient / Not relevant.

14. Time of first gamete release
15. Time of last gamete release
16. Additional information
17. Key references

SENSITIVITY (Larval)

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date first entered
5. **Sensitivity to factors:**

<table>
<thead>
<tr>
<th>Physical factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substratum loss</td>
</tr>
<tr>
<td>Smothering</td>
</tr>
<tr>
<td>Siltation</td>
</tr>
<tr>
<td>Desiccation</td>
</tr>
<tr>
<td>Changes in emergence regime</td>
</tr>
<tr>
<td>Changes in water flow rate</td>
</tr>
<tr>
<td>Changes in temperature</td>
</tr>
<tr>
<td>Changes in turbidity</td>
</tr>
<tr>
<td>Changes in wave exposure</td>
</tr>
<tr>
<td>Noise</td>
</tr>
<tr>
<td>Visual presence</td>
</tr>
<tr>
<td>Chemical factors</td>
</tr>
<tr>
<td>Synthetic compounds</td>
</tr>
<tr>
<td>Heavy metals</td>
</tr>
<tr>
<td>Hydrocarbons</td>
</tr>
<tr>
<td>Radionuclides</td>
</tr>
<tr>
<td>Changes in nutrient levels</td>
</tr>
<tr>
<td>Changes in salinity</td>
</tr>
<tr>
<td>Changes in oxygenation</td>
</tr>
<tr>
<td>Biological factors</td>
</tr>
<tr>
<td>Abrasion / Impact causing damage to the organism</td>
</tr>
<tr>
<td>Displacement of the organism</td>
</tr>
<tr>
<td>Introduction of microbial pathogens</td>
</tr>
<tr>
<td>Introduction of non-native species and translocation</td>
</tr>
<tr>
<td>Selective extraction of this species</td>
</tr>
<tr>
<td>Selective extraction of other species</td>
</tr>
</tbody>
</table>

6. **Confidence**

   - High, Moderate, low, very low, not relevant

7. **Additional information**

8. **Key references**

---

**SENSITIVITY (Adult)**

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date first entered
5. Sensitivity to factors
   - See table above for factors
6. Recoverability following removal of factor
   - See table above for factors
7. Confidence
8. Additional information
9. Key references

---

**IMPORTANCE**

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date first entered

**Marine Natural Heritage Importance**

5. Legislation
### Protected status or relevance under directives and conventions
- Berne
- CITES
- EC Habitats Directive
- W&C 1981 Act
- NI Act
- UK Biodiversity Action Plans
- IUCN categories
- Other

### Rarity
Is the species nationally rare or scarce?

### Biotope or Ecosystem Importance

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the species create space in assemblage?</td>
<td>Little / Moderate / Lots / No / Field not researched / No information found / Data deficient / Not relevant.</td>
</tr>
<tr>
<td>Does the species occupy space and exclude?</td>
<td>Little / Moderate / Lots / No / Field not researched / No information found / Data deficient / Not relevant.</td>
</tr>
<tr>
<td>Does the species provide structure without which the biotope would not exist?</td>
<td>Substratum / Crevices / Shelter / No / Field not researched / No information found / Data deficient / Not relevant.</td>
</tr>
<tr>
<td>Does the species provide a unique food source?</td>
<td>Yes / No / Field not researched / No information found / Data deficient / Not relevant.</td>
</tr>
</tbody>
</table>

### For What?

#### Commercial Importance

<table>
<thead>
<tr>
<th>Utilisation</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicinal use</td>
<td>Yes / No / Field not researched / No information found / Data deficient / Not relevant.</td>
</tr>
<tr>
<td>Trade use</td>
<td></td>
</tr>
<tr>
<td>Aquaculture use</td>
<td></td>
</tr>
<tr>
<td>Harvested (targeted)</td>
<td></td>
</tr>
<tr>
<td>Harvested (by-catch)</td>
<td></td>
</tr>
<tr>
<td>Curio use</td>
<td></td>
</tr>
<tr>
<td>Research use</td>
<td></td>
</tr>
<tr>
<td>Culinary use</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

### Management measures
None, Quota or take limited by numbers, Quota or take limited by effort, Restriction of movement of this species, Restriction of movement of host species, technical restriction in methods of collection, habitat maintenance, habitat enhancement, reintroduction, ex-situ breeding, culling.

### Additional Information

### Key references
Biotope Biology and Sensitivity Key Information Data Entry Fields
Revised Draft 3 October 1999

(MERMAID) = Linked data from MIT Mermaid pages)

BASIC INFORMATION

Biotope / Habitat name
MNCR Biotope code
Description

BIOTOPE CLASSIFICATION

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date of last edit

UK and Ireland Classification
5. MNCR Habitat Complex
6. MNCR Biotope Complex
7. MNCR Biotope
8. Similar Biotopes Other biotopes that could be confused with this biotope or characterized by the same species

Other Classification
9. Habitat Directive Annex I habitat:
10. Additional Information Other classifications (for example, ZNIEFF-MER, Wadden Sea, Helcon.

11. Key references

GENERAL BIOLOGY

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date of last edit
5. Ecological Relationships
6. Habitat Complexity
7. Productivity
8. Temporal Changes
9. Recruitment processes
10. Time for the community to reach maturity
11. Biotope importance for other species
12. Additional Information
13. Key references

HABITAT PREFERENCES AND DISTRIBUTION

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date of last edit
5. British and Irish Distribution
6. Global distribution
7. Habitat preferences
   • Substratum (MERMAID)
   • Zone (MERMAID)
   • Depth range (MERMAID)
   • Wave exposure (MERMAID)
   • Tidal streams (MERMAID)
   • Salinity (MERMAID)
   • Temperature range preference
   • Water quality preference  High/Low turbidity; Presence/Absence of suspended sediment
   • Limiting nutrients  E.g., Nitrogen, Phosphates, Calcium
   • Other preferences
8. Additional Information
9. Key references

SPECIES COMPOSITION

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date of last edit
5. Characterizing species (MERMAID)  Species name, abundance, frequency, faithfulness
6. Species characteristic of sensitivity  Key structural/functional, characteristic, important structural/function
7. Species richness  Very rich/Rich/Moderate/Poor/Very Poor
8. Species found uniquely in the biotope
9. Nationally rare or scarce species associated with biotope
10. Additional information
11. Key references

BIOTOPE SENSITIVITY

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date of last edit
5. Sensitivity to factors (ranked against the factors below)
<table>
<thead>
<tr>
<th>Physical factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substratum loss</td>
</tr>
<tr>
<td>Smothering</td>
</tr>
<tr>
<td>Siltation</td>
</tr>
<tr>
<td>Abrasion</td>
</tr>
<tr>
<td>Selective extraction</td>
</tr>
<tr>
<td>Displacement</td>
</tr>
<tr>
<td>Changes in emergence regime</td>
</tr>
<tr>
<td>Changes in water flow rate</td>
</tr>
<tr>
<td>Changes in temperature</td>
</tr>
<tr>
<td>Changes in turbidity</td>
</tr>
<tr>
<td>Changes in wave exposure</td>
</tr>
<tr>
<td>Noise</td>
</tr>
<tr>
<td>Visual presence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthetic compounds</td>
</tr>
<tr>
<td>Heavy metals</td>
</tr>
<tr>
<td>Hydrocarbons</td>
</tr>
<tr>
<td>Radionuclides</td>
</tr>
<tr>
<td>Changes in nutrient levels</td>
</tr>
<tr>
<td>Changes in salinity</td>
</tr>
<tr>
<td>Changes in oxygenation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biological factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of microbial pathogens</td>
</tr>
<tr>
<td>Introduction of non-native species and translocation</td>
</tr>
<tr>
<td>Selective extraction of this species</td>
</tr>
<tr>
<td>Selective extraction of other species</td>
</tr>
</tbody>
</table>

| Other                         |

6. Recoverability (ranked against the above factors)
7. Likely change in species richness  Major decline/decline/minor decline/no change/ rise/ not relevant.
8. Confidence
9. Biotope Species Sensitivity and Recoverability
   • Presentation of sensitivity assessments for species that characterize biotope sensitivity
   • Presentation of recoverability assessments for species that characterize biotope sensitivity
10. Additional information
11. Key references

**IMPORTANCE**

1. Information researched by
2. Information entered by
3. Information refereed by
4. Date of last edit

**Marine Natural Heritage Importance**

5. Legislation
   Protected status or relevance under directives and conventions
   • Berne Convention
   • CITES
   • EC Habitats Directive
   • Wildlife & Countryside Act (W&C) 1981.
   • NI Act
UK Biodiversity Action Plans
UK Biodiversity Action Plan habitat
Other

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td><strong>Nationally Rare or Scarce</strong></td>
</tr>
<tr>
<td>7.</td>
<td><strong>Commercial Importance</strong></td>
</tr>
<tr>
<td>8.</td>
<td>Aquaculture use</td>
</tr>
<tr>
<td>9.</td>
<td>Harvested use</td>
</tr>
<tr>
<td>10.</td>
<td>Research use</td>
</tr>
<tr>
<td>11.</td>
<td>Other</td>
</tr>
<tr>
<td>12.</td>
<td><strong>Habitat Management</strong></td>
</tr>
<tr>
<td>13.</td>
<td>Management</td>
</tr>
<tr>
<td>14.</td>
<td>Additional Information</td>
</tr>
<tr>
<td>15.</td>
<td>Key references</td>
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</tbody>
</table>