Assessing the sensitivity of seabed biotopes to human activities and natural events

MarLIN

The Marine Life Information Network for Britain & Ireland

www.marlin.ac.uk

Introduction

The Marine Life Information Network (*MarLIN*) offers a new tool for environmental managers by bringing together scientific information into a Web-based resource. *MarLIN* has been developed at a time when improving our stewardship of the marine environment has a high profile in the UK. Such stewardship initiatives are particularly important when resources are under increasing pressure and, in some circumstances, showing significant stress.

Fundamental to improved marine stewardship is better knowledge of where resources are and how they respond to human uses and activities. The *MarLIN* programme has been specifically developed to serve those requirements. The information available from *MarLIN* ranges from basic descriptions of where species and biotopes occur, to what they look like and on to much more detailed information including technical references. *MarLIN* information is also needed to support new management approaches such as those being developed for the Water Framework Directive and to concepts such as good ecological status for marine ecosystems, which are central in the development of the European Union marine strategy. The work of *MarLIN* therefore informs many current initiatives:

- the Habitats Directive;
- OSPAR Annex V;
- the Water Framework Directive;
- Biodiversity Action Plans;
- the Strategic Environmental Assessment Directive;
- local Environmental Impact Assessments;
- licensing of activities;
- sensitivity mapping;
- spatial planning; and
- interpretation of the results of monitoring.

This brochure explains the approach developed and applied in the *MarLIN* programme to assessing the sensitivity of seabed biotopes to human activities and natural events.

Species in intertidal biotopes may have a high sensitivity to environmental change outside of that naturally experienced, or to pollution (an oil spill would most likely kill many of the species in this underboulder biotope). However, recovery may be rapid and, within a few months or years, the biotope will have re-established. (Image: Keith Hiscock.)

Box 1. Core definitions

'Biotope'
refers to the combination of the physical environment (habitat) and its distinctive assemblage of conspicuous species. For practical reasons of interpretation of terms used in directives, statutes and conventions, in some documents, 'biotope' is sometimes synonymized with 'habitat'.

'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' (such as crevices, overhangs, or rockpools) and 'modifiers' (for example sand-scour, wave-surge, or substratum mobility).

'Community'
refers to 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. The community is usually considered the biotic element of a biotope.

'Sensitivity'
is the intolerance of a habitat, community or species (i.e. the components of a biotope) to damage, or death, from an external factor. Sensitivity must be assessed relative to change in a specific factor.

'Recoverability'
is the ability of a habitat, community or species (i.e. the components of a biotope) to return to a state close to that which existed before the activity or event caused change.

'Benchmarks'

In assessing sensitivity, precedence is given to using direct evidence of the effects of changes in environmental factors on a biotope. However, the magnitude of a 'factor' may vary widely from one event to another. It is therefore necessary to identify 'benchmarks' that define the degree of change in a factor. As far as possible, the benchmarks are set at a level of change likely to occur.

Developing a sensitivity assessment rationale

The *MarLIN* approach to assessing sensitivity was built on a review of the strengths and weaknesses of existing approaches, especially work by Holt *et al*. (1995, 1997), studies commissioned or undertaken by the nature conservation agencies in the UK, the ICES Benthos Working Group workshops and meetings of the OSPAR IMPACT group (now Biodiversity Committee), together with subsequent development by *MarLIN*. The standard terms and scales employed are shown in Boxes 1,2, 3 and 4.

Box 2. Species indicative of biotope sensitivity.

Rank	Criteria
Key structural species	The species provides a distinct habitat that supports an associated community. Loss/degradation of the population of this species would result in loss/degradation of the biotope.
Key functional species	The species maintains community structure and function through interactions with other members of that community (for example, predation, grazing, and competition). Loss/degradation of the population of this species would result in rapid, cascading changes in the biotope.
Important characterizing species	The species is/are characteristic of the biotope and is/are important for the classification of the biotope. Loss/degradation of populations of these species would result in loss of that biotope.
Important structural species	The species positively interacts with the key or characterizing species and is important for their viability. Loss/degradation of populations of these species would likely reduce the viability of the key or characterizing species. For example, these species may prey on parasites, epiphytes or disease organisms of the key or characterizing species.
Important functional species	The species is/are the dominant source of organic matter or primary production within the ecosystem. Loss/degradation of these species could result in changes in the community function and structure.
Important other species	Additional species that do not fall under the above criteria but where present knowledge of the ecology of the community suggests they may affect the sensitivity of the community.

Horse mussels, *Modiolus modiolus*, are long-lived and slow growing. Once lost, for example, due to a low salinity event, dredging for scallops, increase in temperature or disease, they are unlikely to recolonize and re-form the pre-existing *Modiolus* biotope for several decades, if at all, i.e. they have a 'very low' recoverability. (Image: JNCC.)

Box 3. Biotope sensitivity.

Rank	Definition
High	Key structural or key functional species in the biotope are likely to be killed and/or the habitat is likely to be destroyed by the factor under consideration.
Intermediate	The population(s) of key structural or key functional species in the biotope 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.
Low	Key structural or key functional species in the biotope 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 may be reduced.
Not sensitive	The factor does not have a detectable effect on structure and functioning of a biotope or the survival or viability of key structural or key functional/important species.
Not sensitive*	The extent or species richness of a biotope may be increased or enhanced by the factor.
Not relevant	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 affected by increased emergence regime).

Box 4. Biotope recoverability.

Rank	Definition
None	Recovery is not possible.
Very low / none	Partial recovery is only likely to occur after about 10 years and full recovery may take over 25 years or never occur.
Low	Only partial recovery is likely within 10 years and full recovery is likely to take up to 25 years.
Moderate	Only partial recovery is likely within 5 years and full recovery is likely to take up to 10 years.
High	Full recovery will occur but will take many months (or more likely years) but should be complete within about five years.
Very high	Full recovery is likely within a few weeks or at most 6 months.
Immediate	Recovery immediate or within a few days.
Not relevant	For when sensitivity is not relevant or cannot be assessed. Recoverability cannot have a value if there is no sensitivity and is thus 'Not relevant'.

Undertaking the research

The biotopes researched by *MarLIN* are those identified and catalogued by the Marine Nature Conservation Review (Connor *et al.*, 1997 a,b) (also available from www.jncc.gov.uk/mermaid). The information that is researched to populate the database and produce information on Web pages is listed below.

- Basic information
- Biotope classification
- Ecology
  - Ecological relationships
  - Seasonal and longer term change
  - Habitat complexity
  - Productivity
  - Recruitment processes
  - Time for the community to reach maturity
- Habitat preferences and distribution
- Species composition
- Sensitivity and recoverability
- Marine natural heritage importance

The sensitivity of a biotope is assessed on the basis of the sensitivity of its component species – especially those that, if killed or reduced in abundance by a factor, would lead to loss of the biotope. The factors against which sensitivity is assessed are listed in Box 5 and the definitions of decline in species richness in Box 6.

The process of assessing sensitivity of a biotope is summarized in Figure 1. The evidence and key information used to assess sensitivity and any judgements made are explained in the on-line rationale for each assessment. The source of all information used is clearly referenced on-line.

Species may be susceptible to displacement by storms ('increase in wave exposure') and suffer mortality as a result. (Image: Keith Hiscock.)

Box 5. Likely sensitivity for each biotope is researched for the following factors.

Substratum loss
Smothering
Suspended sediment
Desiccation
Changes in emergence regime
Changes in water flow rate
Changes in temperature
Changes in turbidity
Changes in wave exposure
Noise
Visual presence
Abrasion and physical disturbance
Displacement
Synthetic compounds
Heavy metals
Hydrocarbons
Radionuclides
Changes in nutrient levels
Changes in salinity
Changes in oxygenation
Introduction of microbial pathogens
Introduction of non-native species and translocation
Selective extraction of this key important characterizing species
Selective extraction of other species

Box 6. Change in species richness.

Rank	Definition
Major decline	The number of species in the biotope is likely to decrease significantly (>75% of species) in response to the factor, probably because of mortality and loss of habitat. For example, a change from very rich to very poor on the Marine Natural Heritage Assessment Protocol (MNHAP) scales (Hiscock, 1996; Connor & Hill, 1998).
Decline	The biotope is likely to lose some of its species in response to the factor by either direct mortality or emigration.
Minor decline	The biotope is likely to lose few species (<25% of species) in response to the factor. For example, a decrease of one level on the MNHAP scales (Hiscock, 1996; Connor & Hill, 1998).
No change	The factor is unlikely to change the species richness of the biotope.
Rise	The number of species in the biotope may increase in response to the factor. (Note the invasion of the community by aggressive or non-native species may degrade the community).
Not relevant	It is extremely unlikely for a factor to occur (e.g. emergence of a deep water community) or the community is protected from the factor.

Gravel sea bed stabilized by the file shell *Limaria hians* (biotope: IMX. Lim). An opened *Limaria* 'nest' is in the foreground. Maintaining the richness of biotopes of marine natural heritage importance requires knowledge of the factors likely to adversely affect them. (Image: Keith Hiscock.)

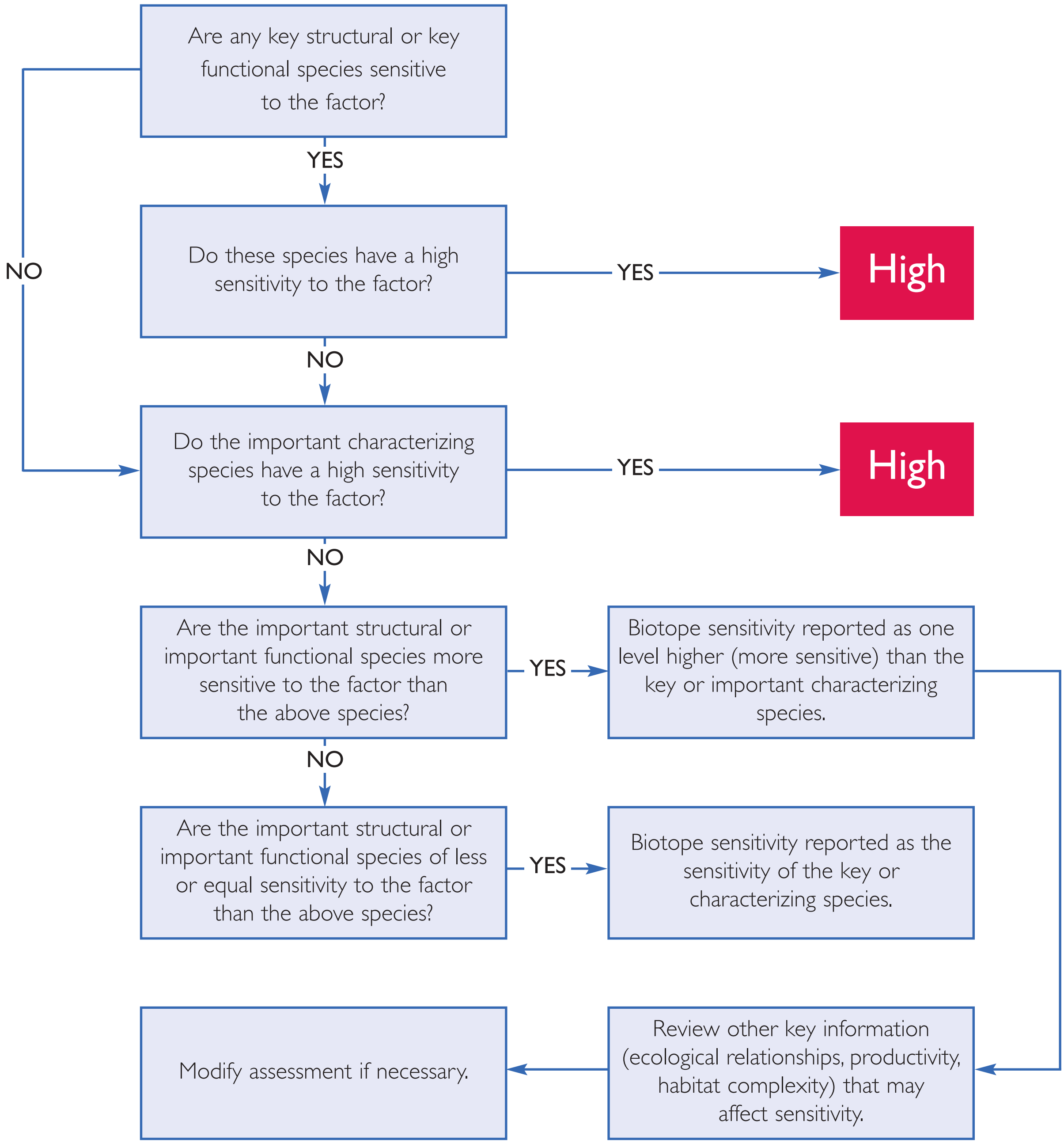


Figure 1. Biotope sensitivity assessment procedure.

The MarLIN database and Web site

(www.marlin.ac.uk)

The Biology and Sensitivity Key Information reviews are 'housed' in a custom designed Microsoft® Access database. The database allows users to interrogate the information held in it directly and search for information on biotopes by:

- biotope code and keywords in the biotope description;
- species name;
- habitats (as biotopes) listed in UK Biodiversity Action Plan habitats;
- habitats (as biotopes) included within Annex I Habitats of the 'Habitats Directive' (92/43/EEC); and
- habitats (as biotopes) sensitive to specified maritime activities or natural events.

The Biology and Sensitivity Key Information reviews are published via the World Wide Web on the *MarLIN* Web site. The layout of the web pages is designed to be informative and easy to interpret (see, for example Figure 2).

At the end of 2002, the *MarLIN* Web site hosted reviews of the biology and sensitivity of 117 biotopes that had been identified in the interest features of candidate marine Special Areas of Conservation (SACs). The biotopes researched were representative of a further 157 biotopes and sub-biotopes.

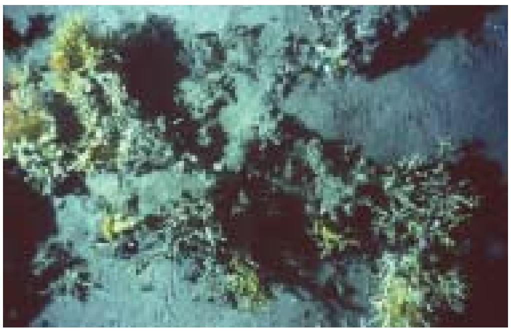
The key information reviews on the Web site include representatives of the most common or widely distributed seabed biotopes in British waters and of their key structural, key functional or important characterizing species. The proportion of biotopes researched identified as occurring in the interest features of the Annex I Habitats of Habitats Directive are shown in Figure 3.

The information researched also included:

- 28 nationally rare or scarce biotopes; and
- 65 biotopes included in UK BAP Habitats.

In addition, the *MarLIN* Web site hosts a total of 149 full Biology and Sensitivity Key Information reviews of marine species and basic information on over 280 marine species including:

- 46 UK Biodiversity Action Plan (BAP) marine species, of which 27 are full reviews;
- full reviews of the lagoonal specialist invertebrates listed in the Saline Lagoon Habitat BAP;
- basic information on 78 species designated or listed under statute or conventions, of which 35 are full reviews; and
- basic information on 63 nationally rare or scarce species, of which 18 are full reviews.



Deep water reefs created mainly by the branching coral *Lophelia pertusa* are included in *MarLIN* research. Part of the Darwin Mounds off north-west Scotland. (Image: Brian Bett/Southampton Oceanography Centre.)

Figure 2. One of the screens from the *MarLIN* Web site.

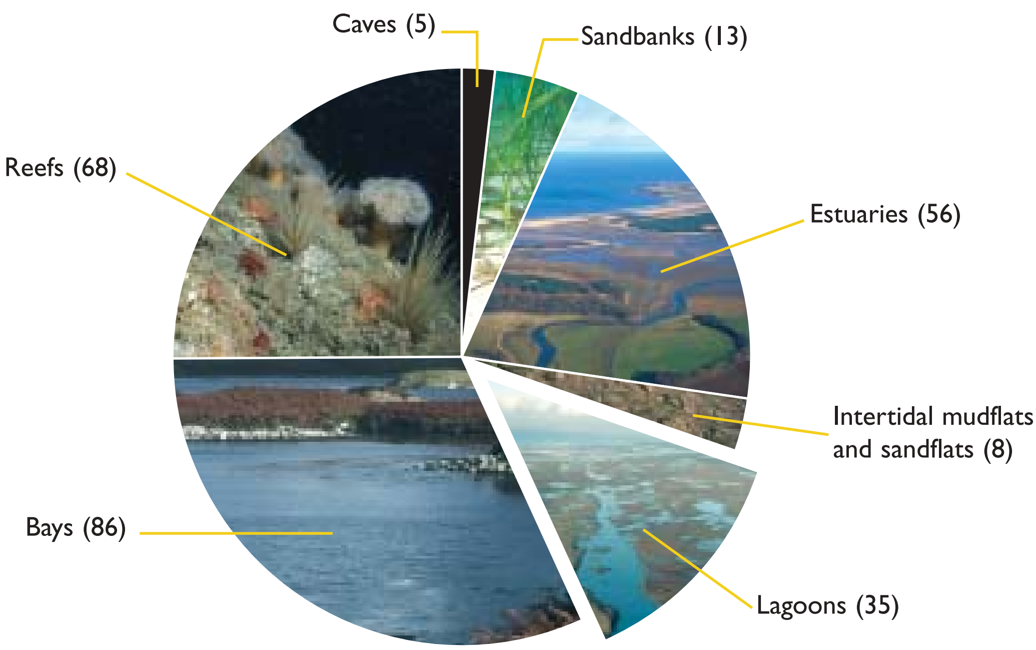


Figure 3. Number of biotopes researched within Habitats Directive Annex I habitats.

Incorporating MarLIN sensitivity information into decision-making

Information from *MarLIN* can be incorporated into the decision-making process and is especially valuable in answering the "will it matter if…?" question from the point-of-view of conservation of biodiversity.

The *MarLIN* Web site is intended to inform:

- protected-site managers;
- developers and their consultants proposing new activities;
- regulatory agencies considering likely impacts of new developments;
- regulatory agencies interpreting results of monitoring; and
- research workers requiring a review of existing information on a species or biotope.

Figure 4 presents a decision tree demonstrating how sensitivity (intolerance), recoverably and importance information from the *MarLIN* Web site can be integrated into environmental assessment and management.

Developing the programme

The *MarLIN* programme is developing a rationale to combine 'sensitivity' *sensu stricto* (=intolerance to a factor) and recoverability into a single scale, which lends itself to the preparation of GIS based maps of coastal sensitivity to environmental change. The change in approach will adopt the definition of sensitivity used in the UK Governments Review of Marine Nature Conservation and Marine Stewardship Report: 'a "sensitive" habitat or species is one that is easily adversely affected by a human activity, and is expected to only recover over a long period'. Therefore, *MarLIN* 'sensitivity' will subsequently be termed 'intolerance'.

The approach developed by *MarLIN* is being promoted for use throughout the north-east Atlantic helped by the compatibility of the biotope classification used with that being developed within the European Union Nature Information System (EUNIS).

The value of the information already produced will be strengthened by research into further biotopes and extension of the research to offshore biotopes. Revisions of the biotopes classification currently underway may require some adjustments to the *MarLIN* database and reviews. The *MarLIN* programme values the views of users, which can be made through the Web site.

Environmental assessments of likely impacts of development can benefit from the summary of information on sensitivity and marine natural heritage importance researched by *MarLIN*. (Image: Paul Gilliland/English Nature.)

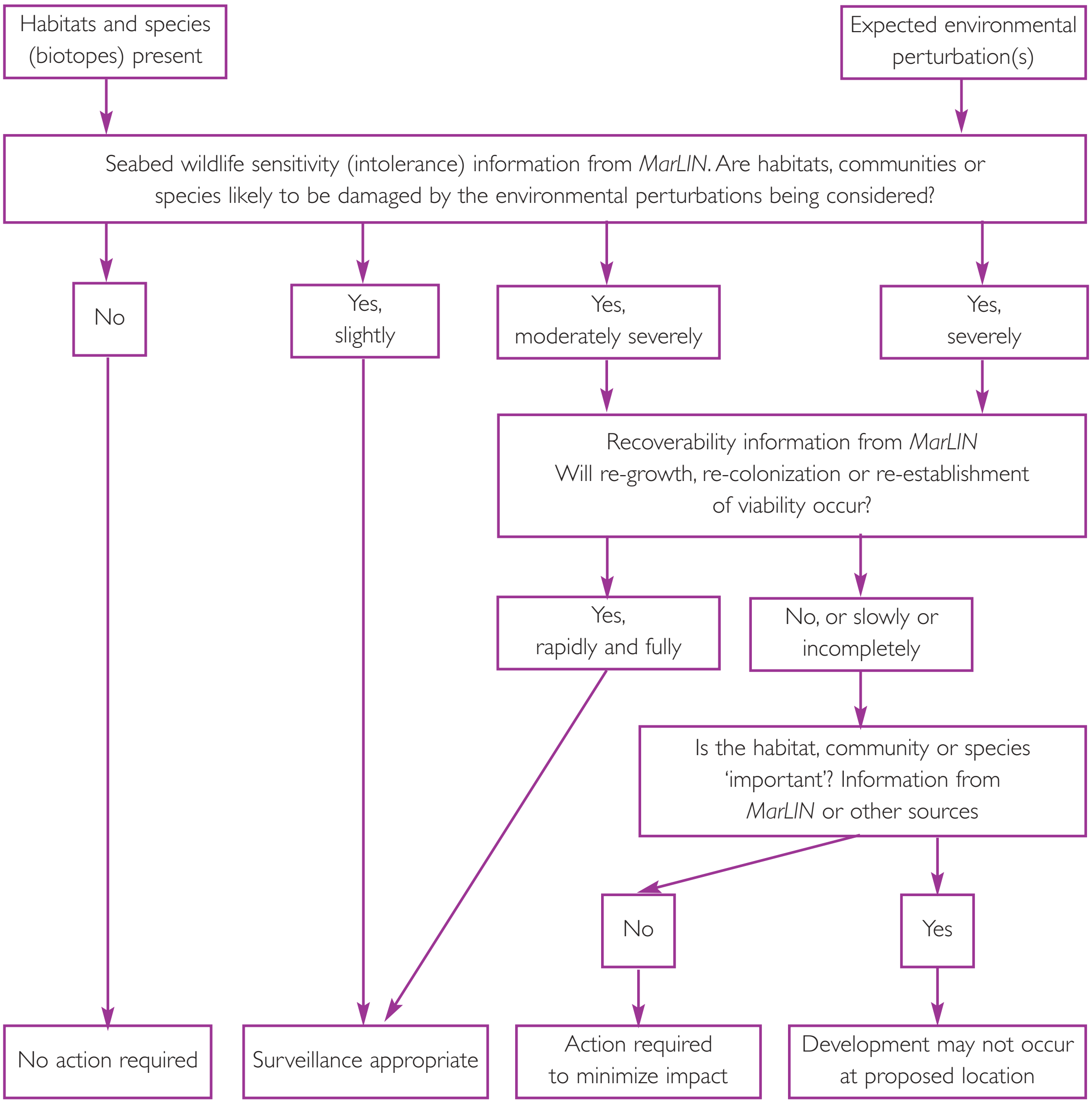


Figure 4. Integrating information from *MarLIN* into environmental assessment and management.

References

Connor, D.W., Brazier, D.P., Hill, T.O. & Northen, K.O., 1997a. Marine Nature Conservation Review: marine biotope classification for Britain and Ireland. Volume 1. Littoral biotopes. Version 97.06. Joint Nature Conservation Committee, Peterborough, JNCC Report, no. 229.

Connor, D.W., Dalkin, M.J., Hill, T.O., Holt, R.H.F. & Sanderson, W.G., 1997b. Marine Nature Conservation Review: marine biotope classification for Britain and Ireland. Volume 2. Sub-littoral biotopes. Version 97.06. Joint Nature Conservation Committee, Peterborough, JNCC Report, no. 230.

Connor, D.W. & Hill, T.O., 1998. Marine Nature Conservation Review natural heritage assessment protocol. Version 98.01. (Unpublished report.) Peterborough: Joint Nature Conservation Committee.

Defra (Department of the Environment, Food and Rural Affairs), 2002. Safeguarding our seas: a strategy for the conservation and sustainable development of our marine environment. London: Crown copyright.

Hiscock, K., ed., 1996. Marine Nature Conservation Review: rationale and methods. Peterborough, Joint Nature Conservation Committee. [Coasts and Seas of the United Kingdom. MNCR series].

Holt, T.J., Jones, D.R., Hawkins, S.J. & Hartnoll, R.G., 1995. The sensitivity of marine communities to man-induced change - a scoping report. Countryside Council for Wales, Bangor, CCW Contract Science Report, no. 65.

Holt, T.J., Jones, D. R., Hawkins, S.J. & Hartnoll, R.G., 1997. The sensitivity of marine communities to man-induced change. Nature Conservation and the Irish Sea seminar. 6th February 1997, pp 6-23. Irish Sea Forum, Liverpool, Seminar Report no. 15.

Biology and Sensitivity Key Information is available on-line for the following biotopes:

LITTORAL ROCK *(and other hard substrata)*

LICHENS AND ALGAL CRUSTS
- Chrysophyceae on vertical upper littoral fringe soft rock (LR.L.Chr)
- Yellow and grey lichens on supralittoral rock (LR.L.YG)

EXPOSED LITTORAL ROCK *(mussel and barnacle shores)*
- *Mytilus edulis* and barnacles on very exposed eulittoral rock (ELR.MB.MytB)
- Barnacles and *Patella* spp. on exposed or moderately exposed, or vertical sheltered eulittoral rock (ELR.MB.Bpat)
- *Fucus distichus* subsp. *anceps* and *Fucus spiralis* f. *nana* on extremely exposed upper eulittoral rock (ELR.FR.Fdis)
- *Corallina officinalis* on very exposed lower eulittoral rock (ELR.FR.Coff)
- *Himanthalia elongata* and red seaweeds on exposed lower eulittoral rock (ELR.FR.Him)

MODERATELY EXPOSED LITTORAL ROCK
(barnacle and fucoid shores)
- Barnacles and fucoids (moderately exposed shores) (MLR.BF)
- *Fucus serratus* and under-boulder fauna on lower eulittoral boulders (MLR.BF.Fser.Fser.Bo)
- *Ceramium* sp. and piddocks on eulittoral fossilised peat (MLR.R.Rpid)
- *Rhodothamniella floridula* on sand-scoured lower eulittoral rock (MLR.Eph.Rho)
- *Enteromorpha* spp. on freshwater influenced or unstable upper eulittoral rock (MLR.Eph.Ent)
- *Mytilus edulis* and *Fucus vesiculosus* on moderately exposed mid-eulittoral rock (MLR.MF.MytFves)
- *Sabellaria alveolata* reefs on sand-abraded eulittoral rock (MLR.Sab.Salv)

SHELTERED LITTORAL ROCK *(fucoid shores)*
- *Ascophyllum nodosum* on very sheltered mid eulittoral rock (SLR.F.Asc)
- *Ascophyllum nodosum* ecad *mackaii* beds on extremely sheltered mid eulittoral mixed substrata (SLR.FX.AscX.mac)
- *Fucus ceranoides* on reduced salinity eulittoral rock (SLR.F.Fcer)
- *Fucus vesiculosus* on mid eulittoral mixed substrata (SLR.FX.FvesX)
- Barnacles and *Littorina littorea* on unstable eulittoral mixed substrata (SLR.FX.Bllit)

LITTORAL ROCK *(other)*
- Green seaweeds (*Enteromorpha* spp. and *Cladophora* spp.) in upper shore rockpools (LR.Rkp.G)
- *Corallina officinalis* and coralline crusts in shallow eulittoral rockpools (LR.Rkp.Cor)
- Overhangs and caves (LR.Ov)
- *Rhodothamniella floridula* in littoral fringe soft rock caves (LR.Ov.RhoCv)

LITTORAL SEDIMENTS

LITTORAL GRAVELS AND SANDS
- Barren coarse sand shores (LGS.S.BarSnd)
- *Pectenogammarus planicrurus* in mid shore well-sorted gravel or coarse sand (LGS.Sh.Pec)
- Talitrid amphipods in decomposing seaweed on the strandline (LGS.S.Tal)
- Burrowing amphipods and *Eurydice pulchra* in well-drained clean sand shores (LGS.S.Aeur)
- Dense *Lanice conchilega* in tide-swept lower shore sand (LGS.S.Lan)

LITTORAL MUDDY SANDS
- Muddy sand shores (LMS.MS)
- *Zostera noltii* beds in upper to mid shore muddy sand (LMS.Zos.Znol)

LITTORAL MUDS
- *Puccinella maritima* saltmarsh community (LMU.Sm low mid) (NVC SM13)
- *Salicornia* sp. pioneer saltmarsh (LMU.Sm) (NVC SM8)
- *Hediste diversicolor* and *Macoma balthica* in sandy mud shores (LMU.Smu.HedMac)

INFRALITTORAL ROCK *(and other hard substrata)*

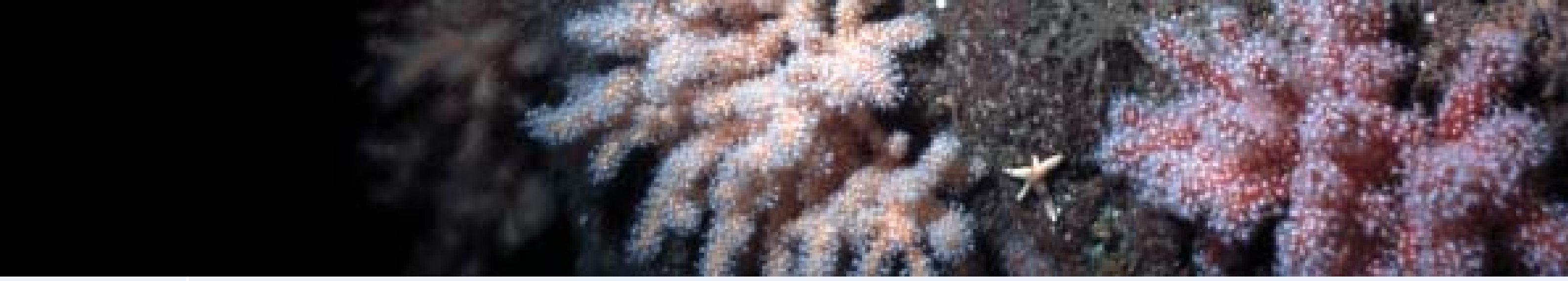
EXPOSED INFRALITTORAL ROCK
- *Alaria esculenta* on exposed sublittoral fringe rock (EIR.KfaR.Ala)
- *Laminaria hyperborea* forest with a faunal cushion (sponges and polyclinids) and foliose red seaweeds on very exposed infralittoral rock (EIR.KfaR.LhypFa)
- *Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock (EIR.KfaR.LhypR)
- *Laminaria saccharina* and/or *Saccorhiza polyschides* on exposed infralittoral rock (EIR.KfaR.LsacSac)
- Foliose red seaweeds on exposed or moderately exposed lower infralittoral rock (EIR.KfaR.FoR)
- Sponge crusts and anemones on wave-surged vertical infralittoral rock (EIR.SG.SCAn)
- *Laminaria digitata* on moderately exposed sublittoral fringe rock (MIR.KR.Ldig.Ldig)
- *Laminaria digitata* and piddocks on sublittoral fringe soft rock (MIR.KR.Ldig.Pid)
- *Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock (MIR.SedK.SabKR)
- Grazed *Laminaria hyperborea* with coralline crusts on infralittoral rock (MIR.LhypGz)
- *Laminaria saccharina*, *Chorda filum* and dense red seaweeds on shallow unstable infralittoral boulders and cobbles (MIR.SedK.LsacChoR)
- *Halidrys siliquosa* and mixed kelps on tide-swept infralittoral rock with coarse sediment (MIR.SedK.HalXK)
- *Polyides rotundus, Ahnfeltia plicata*, and *Chondrus crispus* on sand-covered infralittoral rock (MIR.SedK.PolAhn)

SHELTERED INFRALITTORAL ROCK
- *Laminaria saccharina* park on very sheltered lower infralittoral rock (SIR.K.Lsac.Pk)
- *Laminaria saccharina*, foliose red seaweeds, sponges and ascidians on tide-swept infralittoral rock (SIR.K.Lsac.T)
- *Laminaria saccharina* on reduced salinity infralittoral rock (SIR.K.LsacRS)
- *Mytilus edulis* beds on reduced salinity tide-swept infralittoral rock (SIR.EstFa.MytT)
- *Cordylophora caspia* and *Electra crustulenta* on reduced salinity infralittoral rock (SIR.EstFa.CorEle)
- *Hartlaubella gelatinosa* and *Conopeum reticulum* on low salinity infralittoral mixed substrata (SIR.EstFa.HarCon)
- Mixed fucoids, *Chorda filum* and green seaweeds on reduced salinity infralittoral rock (SIR.Lag.FchoG)
- *Ascophyllum nodosum* with epiphytic sponges and ascidians on variable salinity infralittoral rock (SIR.Lag.AscSAs)
- *Polyides rotundus* and/or *Furcellaria lumbricalis* on reduced salinity infralittoral rock (SIR.Lag.PolFur)

INFRALITTORAL ROCK (other)
- *Alcyonium digitatum* and a bryozoan, hydroid and ascidian turf on moderately exposed vertical infralittoral rock (IR.FaSwV.AlcBytH)

CIRCALITTORAL ROCK *(and other hard substrata)*

EXPOSED CIRCALITTORAL ROCK
- *Pomatoceros triqueter, Balanus crenatus* and bryozoan crusts on mobile circalittoral cobbles and pebbles (ECR.Efa.PomByC)
- *Halichondria bowerbanki, Eudendrium arbusculum* and *Eucratea loricata* on reduced salinity tide-swept circalittoral mixed substrata (ECR.BS.HbowEud)



MODERATELY EXPOSED CIRCALITTORAL ROCK

- Erect sponges, *Eunicella verrucosa* and *Pentapora foliacea* on slightly tide-swept moderately exposed circalittoral rock (MCR.Xfa.ErSEun)
- *Flustra foliacea* and other hydroid/bryozoan turf species on slightly scoured circalittoral rock or mixed substrata (MCR.ByH.Flu)
- *Urticina felina* on sand-affected circalittoral rock (MCR.ByH.Urt)
- *Sabellaria spinulosa* crusts on silty turbid circalittoral rock (MCR.Csab.Sspi)
- *Mytilus edulis* beds with hydroids and ascidians on tide-swept moderately exposed circalittoral rock (MCR.M.MytHAs)
- *Musculus discors* beds on moderately exposed circalittoral rock (MCR.M.Mus)
- *Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata (MCR.M.ModT)
- *Ophiothrix fragilis* and/or *Ophiocomina nigra* beds on slightly tide-swept circalittoral rock or mixed substrata (MCR.Bri.Oph)
- Faunal and algal crusts, *Echinus esculentus*, sparse *Alcyonium digitatum* and grazing-tolerant fauna on moderately exposed circalittoral rock (MCR.GzFa.FaAlC)
- *Molgula manhattensis* and *Polycarpa* spp. with erect sponges on tide-swept moderately exposed circalittoral rock (MCR.As.MolPol)
- Piddocks with a sparse associated fauna in upward-facing circalittoral very soft chalk or clay (MCR.SfR.Pid)
- *Polydora* sp. tubes on upward-facing circalittoral soft rock (MCR.SfR.Pol)

SHELTERED CIRCALITTORAL ROCK

- *Antedon* spp., solitary ascidians and fine hydroids on sheltered circalittoral rock (SCR.BrAs.AntAsH)
- *Suberites* spp. and other sponges with solitary ascidians on very sheltered circalittoral rock (SCR.BrAS.SubSoAs)
- *Neocrania anomala* and *Protanthea simplex* on very sheltered circalittoral rock (SCR.BrAs.NeoPro)

CIRCALITTORAL ROCK (other)

- *Bugula* spp. and other bryozoans on vertical moderately exposed circalittoral rock (CR.FaV.Bug)
- Caves and overhangs (deep) (CR.Cv)

CIRCALITTORAL OFFSHORE ROCK (and other hard substrata)

- *Lophelia* reefs (COR.Lop)

SUBLITTORAL SEDIMENTS

INFRALITTORAL GRAVELS AND SANDS

- *Phymatolithon calcareum* maerl beds with hydroids and echinoderms in deeper infralittoral clean gravel or coarse sand (IGS.Mrl.Phy.Hec)
- *Lithothamnion glaciale* maerl beds in tide-swept variable salinity infralittoral gravel (IGSMrl.Lgla)
- *Halcampa chrysanthellum* and *Edwardsia timida* on sublittoral clean stone gravel (IGS.FaG.HalEdw)
- *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand (IGS.FaS.NcirBat)
- Dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand (IGS.FaS.Lcon)
- *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves in infralittoral compacted fine sand (IGS.FaS.FabMag)
- *Neomysis integer* and *Gammarus* spp. in low salinity infralittoral mobile sand (IGS.EstGS.NeoGam)

CIRCALITTORAL GRAVELS AND SANDS

- Venerid bivalves in circalittoral coarse sand or gravel (CGS.Ven)

INFRALITTORAL MUDDY SANDS

- *Zostera marina/angustifolia* beds in lower shore or infralittoral clean or muddy sand (IMS.Sgr.Zmar)
- *Ruppia maritima* in reduced salinity infralittoral muddy sand (IMS.Sgr.Rup)
- *Echinocardium cordatum* and *Ensis* sp. In lower shore or shallow sublittoral muddy fine sand (IMS.FaMS.EcorEns)
- *Macoma balthica* and *Abra alba* in infralittoral muddy sand or mud (IMS.FaMS.MacAbr)
- *Capitella capitata* in enriched sublittoral muddy sediments (IMS.FaMS.Cap)

CIRCALITTORAL MUDDY SANDS

- *Abra alba, Nucula nitida* and *Corbula gibba* in circalittoral muddy sand or slightly mixed sediment (CMS.AbrNucCor)
- *Amphiura filiformis* and *Echinocardium cordatum* in circalittoral clean or slightly muddy sand (CMS.AfilEcor)
- *Virgularia mirabilis* and *Ophiura* spp. on circalittoral sandy or shelly mud (CMS.VirOph)
- *Serpula vermicularis* reefs on very sheltered circalittoral muddy sand (CMS.Ser)

INFRALITTORAL MUDS

- *Potamogeton pectinatus* community (IMU.Ang.NVC A12)
- *Phragmites australis* swamp and reed beds (IMU.Ang.NVC S4)
- Semi-permanent tube-building amphipods and polychaetes in sublittoral mud or muddy sand (IMU.MarMu.TubeAP)
- *Arenicola marina* and synaptid holothurians in extremely shallow soft mud (IMU.MarMu.AreSyn)
- *Philine aperta* and *Virgularia mirabilis* in soft stable infralittoral mud (IMU.MarMu.PhiVir)
- *Ocnus planci* aggregations on sheltered sublittoral muddy sediment (IMU.MarMu.Ocn)
- *Polydora ciliata* in variable salinity infralittoral firm mud or clay (IMU.EstMu.PolVS)
- *Aphelochaeta marioni* and *Tubificoides* spp. in variable salinity infralittoral mud IMU.EstMu.AphTub)
- *Limnodrilus hoffmeisteri, Tubifex tubifex* and *Gammarus* spp. in low salinity infralittoral muddy sediment (IMU.EstMu.Lim.Ttub)

CIRCALITTORAL MUDS

- *Brissopsis lyrifera* and *Amphiura chiajei* in circalittoral mud (CMU.BriAchi)
- Seapens and burrowing megafauna in circalittoral soft mud (CMU.SpMeg)
- *Beggiatoa* spp. on anoxic sublittoral mud (CMU.Beg)

INFRALITTORAL MIXED SEDIMENT

- *Laminaria saccharina, Chorda filum* and filamentous red seaweeds on sheltered infralittoral sediment (IMX.KSwMx.LsacX)
- Filamentous green seaweeds on low salinity infralittoral mixed sediment or rock (IMX.KSwMx.FiG)
- *Ostrea edulis* beds on shallow sublittoral muddy sediment (IMX.Oy.Ost)
- *Venerupis senegalensis* and *Mya truncata* in lower shore or infralittoral muddy gravel (IMX.FaMx.VsenMtru)
- Burrowing anemones in sublittoral muddy gravel (IMX.FaMx.An)
- *Limaria hians* beds in tide-swept sublittoral muddy mixed sediment (IMX.FaMx.Lim)
- *Crepidula fornicata* and *Aphelochaeta marioni* in variable salinity infralittoral mixed sediment (IMX.EstMx.CreAph)
- *Mytilus edulis* beds in variable salinity infralittoral mixed sediment (IMX.EstMx.MytV)
- *Polydora ciliata, Mya truncata* and solitary ascidians in variable salinity infralittoral mixed sediment (IMX.EstMx.PolMtru)

CIRCALITTORAL OFFSHORE SEDIMENTS

- *Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy very fine sand near margins of deep stratified seas (COS.AmpPar)
- Foramaniferans and *Thyasira* sp. in deep circalittoral soft mud (COS.ForThy)
- *Styela gelatinosa* and other solitary ascidians on sheltered deep circalittoral muddy sediment (COS.Sty)

Other biotopes that are present or likely to be present in SACs are represented by the above biotopes.

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