Common Standards Monitoring Guidance

for

Littoral Rock and Inshore Sublittoral Rock Habitats

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Contents

NOTE: It is essential that the "Introduction to the marine guidance" found at the start to the marine section should be read prior to this littoral rock and inshore sublittoral rock guidance when setting attributes.

1 Definition of littoral rock and inshore sublittoral rock

Littoral and inshore sublittoral rock habitats comprise a wide range of sub-features, particularly where rock extends from the top of the intertidal zone through to the deep circalittoral zone. They are very variable in form and in the communities that they support, and such complexity poses considerable obstacles to achieving a consistent monitoring strategy. For the purposes of the present guidance, 'rock' refers to all type of consolidated, stable rocky habitats - this includes boulder and cobble[1] habitats, and biogenic concretions, that enable an epibenthic community to develop (Johnston et al., 2002). The specific communities that occur vary according to a number of factors, these could include rock type, topographical features such as vertical rock walls, gully and canyon systems, outcrops from sediment and rock pools on the shore, exposure to wave action, temperature changes and turbidity.

Whilst the present guidance provides a single list of attributes, condition assessment must include a consideration of both physical and biological components of the system and it may be appropriate to consider rock in terms of three main zones: intertidal, infralittoral and circalittoral, when setting monitoring objectives. Attributes and targets can then be tailored to the specific interest of each zone. The infralittoral is the subtidal zone in which kelps and seaweeds are the dominant feature of the community. The depth of this zone is variable; in clear waters it can extend as far as 15m. The circalittoral is the subtidal zone characterised by faunal communities. No lower limit is defined, but species composition changes below about 40m to 80m depth. This zone can be subdivided into the upper circalittoral where foliose algae are present and the lower circalittoral zone where they are not.

The term 'littoral rock and inshore sublittoral rock' includes the habitats listed in Box 1.

Box 1 Habitat types included in the term 'littoral rock and inshore sublittoral rock'

Habitats Directive	BAP Broad habitat type[2]	BAP Priority habitat/Action Plan[2]	OSPAR Threatened Habitat[3]
Reefs	Littoral rock	Littoral and sublittoral chalk	Littoral chalk communities
Submerged or partially submerged sea caves	Inshore sublittoral rock	*Sabellaria alveolata* reefs	
Estuaries (in part)		Tidal rapids	
Large shallow inlets and bays (in part)		*Modiolus modiolus* beds	
		Sabellaria spinulosa reefs	
		Serpulid reefs	

[1] Cobbles are generally > 64 mm in diameter.

[2] These are derived from both the Biodiversity: The UK Steering Group Report - Volume II: Action Plans and the *UK Biodiversity Group Tranche 2 Action Plans - Volume V: Maritime species and habitats*. Further information on these habitat types can be found on the UK Biodiversity web site at http://www.ukbap.org.uk/habitats.htm

[3] These are derived from a provisional list agreed by the OSPAR Biodiversity Committee at their Leiden Workshop, 5-9 November 2001, and therefore may change when the final list is agreed.

A condition assessment of littoral and inshore sublittoral rock habitats should be based on the attributes[4] and their associated targets derived from the generic attributes table (Table 1, Section 6).

Section 2 and Table 1 (Section 6) list the generic attributes that are considered most likely to represent the condition of the feature. It will be necessary to develop a site-specific expression of some or all of these generic attributes to represent the conservation interest of the feature properly, fully reflecting any local distinctiveness.

2 Background, targets and monitoring techniques for individual attributes

Table 1 (Section 6) lists seven attributes, three of which (*Extent, Biotope composition, Distribution and spatial pattern of biotopes*) are mandatory for all sites. The rest are site-specific attributes used to highlight local distinctiveness when assessing the overall conservation value of a site and may therefore not be applicable to all sites.

2.1 Extent

Extent of the littoral rock and inshore sublittoral rock is an essential structural component of the feature and therefore **must be assessed for all sites**.

2.1.1 Background to the attribute

The extent of (non-biogenic) rock is unlikely to change significantly over time unless as a result of some human activity, but it nevertheless needs to be measured periodically. A direct measurement may be required for boulder shores or friable bedrock where an alteration in overall extent may occur.

The extent of a biogenic reef is an important attribute in relation to the viability of the reef and therefore should be measured at each assessment (using an index approach or an absolute measure for smaller areas – see below).

Where the field assessment judges extent to be unfavourable, and subsequent investigation reveals the cause is clearly attributable to cyclical natural processes, the final assessment will require expert judgement to determine the reported condition of the feature. The feature's condition could be declared favourable where the officer is certain that the conservation interest of the feature is not compromised by the failure of this attribute to meet its target condition. Where there is a change outside the expected variation or a loss of the conservation interest of the site, (e.g. due to anthropogenic activities or unrecoverable natural losses) then condition should be considered unfavourable.

Extent of bedrock habitats is unlikely to alter significantly as a result of natural processes over a monitoring cycle. Biogenic reefs may vary in their extent both through natural processes or anthropogenic activity and therefore a regular measure of extent will be required to assess their condition. Where changes in extent of biogenic reefs are recorded, the cause of the change is important to determined since this will influence the final assessment of condition.

Storm events may lead to increased sediment deposition and natural loss of extent. If there is a difference in position between different parts of the rock this will need to be indicated on the map/photo and in subsequent assessments.

Changes in extent may be attributable to anthropogenic effects, where coastal protection schemes or coastal development, interrupt natural coastal processes. Such changes in extent would be considered

[4] The Common Standards text defines an attribute as: 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*.

unfavourable and by default the feature would also be declared unfavourable. If the activity had been consented and no adverse effect on integrity has occurred, condition would be considered favourable.

2.1.2 Setting a target

In principle the target should be set at no loss of area of the rock during the monitoring cycle, accommodating any geomorphological trajectory. It may be necessary to set a target that declines each monitoring cycle where there is an established natural loss of extent, or sufficient data available to predict (via a model) a downward trend in extent[5]. Departure from this predicted target then would be a trigger for investigation and the feature may be considered unfavourable.

The target should indicate the recognised area of the feature measured in hectares. It is important that targets set for this attribute are flexible enough to relate to the natural coastal processes involved with this feature (see above).

Biogenic reefs may alter their precise location through natural mortality and recruitment cycles, but there should not be an overall loss of area. There may be an increase in the area of non-biogenic rock through the erosion of overlying sediment. Advice on how to deal with such an eventuality should be included in the site-specific documentation.

In some circumstances, within an entire inshore littoral and sublittoral rock complex the actual areas of highest conservation value may only form a proportion of the total area. Where this occurs, it is important that the site-specific documentation describes such areas. The loss in extent of any of these areas will result in the feature becoming unfavourable.

When measuring extent, the following issues should be considered:

- Check that all aerial photographs and broadscale biotope maps have the same upper and lower tidal/bathymetric boundaries, are at the same scale and to the same datum.
- Storm events and flood water can transport sediment into the system. This may lead to sediment deposition and a decrease in extent.
- Anthropogenic factors such as coastal protection schemes can lead to extent loss or increase.

An example of how a target for this attribute might be expressed is shown in Box 2

Box 2 A site-specific target for the attribute 'Extent'

Target	Comments
No decrease in extent of intertidal rock areas.	Check the area of the most recent aerial photograph against baseline GIS data collected by Bunker, Moore & Perrins (2002). A loss in extent not due to natural processes will result in unfavourable condition. A loss in extent due to unconsented activity/operation will result in unfavourable condition.

*Taken from Plymouth Sound and Estuaries European Marine Site

2.1.3 Suggested techniques

Extent of littoral and inshore sublittoral rock can be measured in absolute terms (e.g. an area- based measurement derived from full coverage mapping techniques), using an index approach such as point sampling over a grid, or by inference (the extent of a rock habitats is unlikely to change if there is no

[5] It may also be possible to predict and increase in extent for biogenic reefs.

geomorphological activity). The type of measure used should be linked to the known or likely threats posed by anthropogenic activities. For example, an absolute measure of the area of a biogenic reef would be required where there was a record of activities that cause physical disturbance of the seabed such as demersal trawling, dredging or dumping. It is unlikely that repeat full coverage mapping would be economically viable on any site.

The Marine Monitoring Handbook (Davies *et al.*, 2001) contains details of the techniques appropriate for monitoring the condition of designated features.

Possible methods provided in the handbook for measuring the extent of the feature are:

- 1-1 Intertidal resource mapping using aerial photographs (for intertidal rock)
- 1-3 Seabed mapping using acoustic ground discrimination interpreted with ground truthing (for subtidal rock).
- 1-4 The application of side scan sonar for seabed mapping (for subtidal rock)

Other proposed methods, not as yet detailed in the handbook are:

- Satellite and airborne multi-spectral remote sensing (Remote imaging);
- Aerial photography and photogrammetry (Air photo interpretation);

The above 2 techniques will provide a precise measure of extent if required for more dynamic habitats such as boulder shores or friable rock and also for measuring the extent of intertidal rock and shallow subtidal rock areas.

Possible methods for measuring the extent of subtidal rock include both remote sensing and direct observation techniques:

- Mapping extent using point samples (preferably using a grid strategy) either using point sample mapping or towed video transects, can be used to determine the edge of littoral and inshore sublittoral rock habitats
- Direct observation by diver or ROV (remotely operated vehicle) using a transect strategy can be used for habitats with a very limited extent.

2.2 Biotope composition

Biotope composition is an essential component of the feature, representing the *structure* and, in part the *function* of the littoral and inshore sublittoral rock and therefore **must be assessed for all sites**.

The site-specific representation of this attribute should clearly reflect the overall biological character of the rock habitats that makes the site special.

2.2.1 Background to the attribute

The biotope composition attribute of littoral rock and inshore sublittoral rock should encompass the variety of biological communities present within the feature and should reflect the conservation interest of the particular site.

The attribute may address a subset of the biotopes identified for the following:

- overall biotope composition where the feature supports a diverse range of communities
- specific biotopes indicative of the character of the site or of conservation interest[6]
- biotopes, which may be indicative of the condition of the feature with respect to the level of anthropogenic activity or input.

[6] Examples would be nationally rare or scare biotopes, or biotopes supporting species of conservation value.

The resolution to which biotopes are expressed in the target will have to be considered with regard to their use in condition assessment. It may be appropriate to use higher level biotopes (e.g. biotope complexes) in preference to the more detailed ones that are difficult to identify in the field.

It is important to understand cyclical succession of biotopes. Biotopes are often defined by differing abundance of species, and under natural conditions certain biotopes will cycle about each other and may disappear and reappear over time. These cycles are an acceptable part of the interest of the feature and must be considered when phrasing a target value. A suite of the biotopes expected at the site should be listed with their 'cyclical partners'.

Where the field assessment judges biotope composition to be unfavourable, and subsequent investigation reveals the cause is clearly attributable to cyclical natural processes (e.g. winter storm/flood events, changes in supporting processes or mass recruitment or dieback of characterising species), the final assessment will require expert judgement to determine the reported condition of the feature. The feature's condition could be declared favourable where the officer is certain that the conservation interest of the feature is not compromised by the failure of this attribute to meet its target condition. Where there is a change in biotope composition outside the expected variation or a loss of the conservation interest of the site, then condition should be considered unfavourable.

The present attribute aims to measure the overall variety of communities throughout an entire site and is distinguished from the attribute *Distribution of biotopes* discussed below which measures the presence or absence of biotopes at specific locations.

2.2.2 Setting a target

It is intended that either:

- a subset of the biotopes should be identified where the feature supports a diverse range of communities, or
- the overall biotope composition be determined and specific notable biotopes highlighted where appropriate.

This information can be derived from biotope maps or from other more detailed survey records.

Targets should be set that require the determination of the presence of the named subset of biotopes from selected areas within a site (sampling locations are also likely to be governed by access and health and safety issues). It is important that the targets and measures set are clear and unambiguous. The targets and measures should determine the resolution (i.e. whether the assessment is based on biotope complex, biotope or sub-biotope level) and the scale of the assessment (i.e. intensity of sampling). The targets should also clearly identify what must be achieved in order to pass or fail (i.e. biotopes X, Y, Z must be present within the feature).

Note the following general points when defining targets for littoral and inshore sublittoral rock features:

- *Biotopes may change in natural cycles:*

If an area changes from one biotope to another, this may be a natural process, possibly part of a natural cycle. It is important not to over-specify targets (biotope x must be present at site y), to avoid the possibility of an area being deemed unfavourable where biotopes have changed as part of a natural process. For example, natural shifts in biotopes are likely to occur on shores dominated by ephemeral algae, such as *Enteromorpha intestinalis* and *Porphyra* spp. Seasonal changes in wave exposure and available light can be significant and winter storms may reduce or remove the algae normally present during the summer months, or alter species composition. A shift from one biotope (i.e. EphX to BlitX) would not normally indicate a decline in the condition of the feature, even a shift from barnacle dominated bedrock [Sem.Sem] to a red algae/fucoid dominated biotope such as barnacles, fucoids and

red seaweeds [Sem.FvesR] can be the result of natural processes[7]. In this particular example, it may be suitable to set the target at the biotope complex level (biotopes within biotope complex Barnacles and *Mytilus* must occur at site y), because the overall species composition will not have changed significantly, but rather the relative abundance of the individual species. Knowledge of local conditions is necessary when setting targets: some biotopes may virtually disappear during stormy winters and re-appear during calm summer months. These cycles are a vital part of the interest of the feature and must be considered when phrasing a target value. In such circumstances, too tightly defined targets could lead to a false judgement of unfavourable condition.

- *Selection of biotopes*

A subset of biotopes of importance may be identified and listed, omitting ephemeral biotopes and biotopes considered to be of low conservation importance. You may only wish to choose biotopes considered being of conservation importance within the site.

- *Species composition of biotopes*

It is not possible to apply a level in the classification hierarchy at which all targets should be set. In some cases a shift from one biotope (or even sub-biotope) to a similar one may signal a decline in environmental quality; in other cases a shift from one complex to another is just part of a natural cycle. For example, within the sheltered fucoids complex, a shift from an *Ascophyllum nodosum* dominated biotope to a *Fucus vesiculosus* dominated biotope would signal a change in environmental quality. As *A. nodosum* can live for longer than 15 years, and requires a certain degree of stability throughout its life, a shift from the *A. nodosum* biotope to one of the other biotopes (within the complex) would signal a significant change in the environmental dynamics of a site quality and should trigger further investigation. On the other hand, a shift from a barnacle/fucoid dominated biotope i.e. FvesB to Fves (different complexes) may just be part of a natural predation/recruitment cycle and should not necessarily trigger further investigation.

- *Data type and quality*

For many littoral rock sites, the biotope composition cannot reliably be identified at the biotope or sub-biotope level during mapping surveys in the field, since quantitative sampling is required to identify the characterising species. It is very important to bear this in mind, especially where habitat maps based on Phase I surveys are available for a particular site: subsequent quantitative surveys may lead to different biotope assignments even if there was no change to the feature. Similarly, if data from an initial quantitative survey were available to establish a target condition, subsequent rapid assessment surveys would not necessarily deliver the same level of detail. Where condition assessments will be based on data from rapid surveys, it is important not to set the target at a too detailed level in the biotope classification, as the field data will not deliver the required level of resolution. It may be necessary to set targets at the biotope complex level if resources won't allow for quantitative surveys to be carried out in future or to work with fewer sites. Data should always be associated with the appropriate level in the hierarchy (i.e. the biotope complex level if the data are not detailed enough to be assigned to biotope or sub biotope level). However, the data should always be assigned to the lowest level possible (i.e. a 'complete' species list should be assigned to biotope/sub biotope level, video surveys to complex level etc), bearing in mind that any given record will be different from the 'idealised' biotope description that is based on a large number of UK records.

SSSI citations, SAC Regulation 33 packages, biotope maps or more detailed survey records should help to determine the biotopes of nature conservation importance within a site, which in turn will determine the target list of biotopes. Due consideration should also be given to activities occurring within sites.

[7] These biotope codes are taken from the revised biotope classification published in Spring 2003 and can be found at **http://www.jncc.gov.uk/marine/biotopes/default.htm**

When setting target values, it is important to consider the following issues:

- An agreed level of biotope discrimination must be clearly established in relation to the national biotope classification scheme. You may wish to use a higher level in the classification where biotopes are difficult to differentiate without detailed sampling;
- A subset of biotopes of importance may be identified and listed, omitting ephemeral biotopes and biotopes considered to be of low conservation importance. You may only wish to choose biotopes considered to be of conservation importance within the site;
- Some biotopes occur in a natural cycle and may disappear and reappear over time. These cycles are a vital part of the interest of the feature and must be considered when phrasing a target value. Too tightly defined targets could lead to a false judgement of unfavourable condition.

An example of how a target for this attribute might be expressed is shown in Box 3

Box 3 A site-specific target for the attribute "Biotope composition of littoral and inshore sublittoral rock"

Target	Comments
Maintain the variety of biotopes below which are characteristic of the site, allowing for natural succession/known cyclical change.	Expect to find the suite of target biotopes within the combined results of the structured walk for the site.
LR.Rkp.Cor; LR.Rkp.Cor.Bif; LR.Rkp.FK; LR.L.Ver.Ver; LR.L.YG; ELR.MB.Bpat.Lic/Cht; ELR.FR.Him; MLR. BF.Fser.R/Fser; SLR. F.Asc.Asc/FSpi	Absence of a biotope from the subset will result in an unfavourable assessment for the feature.

2.2.3 Suggested techniques

Sampling locations should be distributed throughout each site, so that an assessment of overall site condition can reasonably be made. However, due to the large and complex nature of many sites it is likely that a degree of sub-sampling will be essential in most cases, which makes the risk of missing a biotope much greater (due to shifts in sediment, particularly in estuaries) to beyond the sampling area.

It is likely in such cases that emphasis be placed on assessing the continued presence of those biotopes of greatest conservation value. Within some sites these biotopes may be clumped disproportionately within a small section of a larger site and here it would be important to also include biotopes and sampling locations representative of the remainder of the site. More detailed sampling effort should focus on those biotopes of highest conservation value.

Ideally, a mapping or inventory study of all rock biotopes would be undertaken, to provide baseline information to phrase properly the conservation objective for the site-specific attribute. Such a study would also guide more detailed targeted studies to assess biological quality.

All quantitative sampling must be effort-limited to ensure comparability between monitoring events. The sampling strategy will depend on the local topography: transects are more suited to steep habitats; a grid sampling strategy is appropriate to extensive level habitats.

The Marine Monitoring Handbook (Davies *et al.*, 2001) contains details of the techniques appropriate for monitoring the condition of designated features.

Possible methods provided in the handbook for measuring the biotope composition of the intertidal feature are:

- 1-1 Intertidal resource mapping using aerial photographs; with ground validation
- 3-1 *In situ* intertidal biotope recording; making a biotope inventory during a site visit (this may include grid sampling using effort-limited biotope identification techniques),

Possible methods for measuring the biotope composition of subtidal rocky habitats are:

- 3-3 *In situ* survey of subtidal (epibiota) biotopes and species using diving techniques
- 3-5 Identifying biotopes using video recordings (Drop-down video)
- 3-13 *In situ* surveys of sublittoral epibiota using hand-held video
- 3-14 *In situ* survey of sublittoral epibiota using towed sledge video and still photography.

Other proposed methods, not as yet detailed in the handbook are:

- Satellite and airborne multi-spectral remote sensing (Remote imaging); validated with effort-limited biotope identification techniques
- Descriptive and quantitative surveys using remote operated vehicles (ROV).

2.3 Distribution and spatial pattern of biotopes at specified locations

The *distribution and spatial pattern of biotopes at specified locations* is an essential component of the feature, representing the structure and particularly the function of the littoral and inshore sublittoral rock and therefore **must be assessed for all sites**.

2.3.1 Background to the attribute

Distribution refers to the geographic location of biotopes throughout the feature. Spatial pattern refers to the local zonation or juxtaposition of biotopes at specified locations.

Assessing the distribution of biotopes throughout the feature should highlight any progressive loss or change in the biological integrity of the feature. Zonation patterns are a biological integration of the prevailing environmental processes that structure marine communities. A change in zonation may signal an important shift in the local environmental regime due to an anthropogenic activity: for example a shift in the maximum depth of the kelp zone may indicate a change in the ambient light levels due to increased sediment loading of the water column.

This attribute complements an assessment of the biotope composition attribute by ensuring that the distribution of the conservation interest is maintained throughout the feature.

The issues described under *Biotope Composition* in relation to specifying biotopes equally apply to the present attribute. Unlike *Biotope Composition* this attribute is concerned with the presence or absence of biotopes at specific locations and their spatial relationship to one another.

Where a field assessment judges this attribute to be unfavourable and subsequent investigation indicates the cause is due to natural factors, the final assessment will require expert judgement to determine the reported condition of the feature. The feature's condition could be declared favourable where the officer is certain that the conservation interest of the feature is not compromised by the failure of this attribute to meet its target condition. Where there is a change in biotope distribution/spatial pattern outside the expected variation or a loss of the conservation interest of the site, then condition should be considered unfavourable.

2.3.2 Setting a target

The target must consider any expected shift(s) in distribution and spatial pattern. It is possible to use an absolute measure or an index approach to measuring biotope distribution.

Additional issues to consider when specifying site-specific targets include:

- Biotope distribution may change in response to extreme low frequency events such as increased storm/flood occurrence.
- Some biotopes will change their distribution and/or spatial pattern naturally over time, in a cycle with other biotopes (and the target should identify these if possible).

An example of how a target for this attribute might be expressed is shown in **Error! Reference source not found.**

Box 4 A site-specific target for the attribute "Distribution and spatial arrangement of biotopes at specified locations"

Target	Comments
Maintain the distribution and spatial pattern of the biotope subset, allowing for natural succession/ known cyclical change in biotope distribution. Biotopes present are; B Pat, B Pat.Fvesl, B Pat.Sem, Coff, FK, Fser.Fser, Fser.R, Fspi, Fves, FvesB, Him, Ldig, MytB, Por, Rho. The distribution should correspond with (Brazier *et al* 1996). See distribution of biotopes attribute for expected cyclical partners.	Expect to identify the biotope subset in the field at positions derived from the baseline biotope map (Brazier *et al* 1996). Cross-reference with aerial photographs.

*Taken from Berwickshire and North Northumberland Coast cSAC.

2.3.3 Suggested techniques

Remote sensing techniques (AGDS/sidescan sonar) have a limited capability to discriminate between biotopes and are more suited to broad habitat patterns.

A transect based sampling strategy is most appropriate to identify zonation patterns. Transects should be located throughout the feature using a stratified sampling strategy.

Direct observation by diver or remote camera using a transect-based (or occasionally a grid) sampling strategy can also be used.

The Marine Monitoring Handbook (Davies *et al.* 2001) contains details of the techniques appropriate for monitoring the condition of designated features.

Possible methods provided in the handbook for measuring the biotope distribution and spatial pattern of intertidal rocky habitats are:

- 1-2 Fixed viewpoint photography at specified locations.
- 3-1 *In situ* intertidal biotope recording.

- 3-2 *In situ* survey of intertidal biotopes using abundance scales and checklists at exact locations (ACE).
- 3-11 Littoral monitoring using fixed quadrat photography.

Possible methods provided in the handbook for measuring the biotope distribution and spatial pattern of subtidal areas which will provide a comprehensive and continuous measure of the spatial pattern of infralittoral biotopes, are:

- 1-3 Seabed mapping using acoustic ground discrimination interpreted with ground truthing (AGDS).
- 1-4 The application of side scan sonar for seabed mapping

Other proposed methods, not as yet detailed in the handbook are:

- Satellite and airborne multi-spectral remote sensing (Remote imaging)- for shallow areas.

2.4 Extent of sub-feature or representative/notable biotopes

Extent of sub-feature or representative/notable biotopes is considered a site-specific attribute used to highlight local distinctiveness when assessing the overall conservation value of a site and may therefore not be applicable to all sites.

2.4.1 Background to the attribute

This attribute may highlight important structural and functional components of the feature, depending on the biotopes/sub-features chosen. The biotopes chosen should reflect the site-specific interest of the feature. Actual extent may vary on seasonal cycles and the presence or absence of a biotope can change the results quite significantly. It is important to understand cyclical succession of littoral rock and inshore sublittoral rock biotopes, and to take this into account when choosing biotopes to reflect this particular attribute.

This attribute may be of particular relevance to biogenic reefs where they form part of a littoral and inshore sublittoral rock feature that also includes bedrock habitats.

The advice concerning judgement of the feature condition provided under Extent (*Section 2.1.1 Background to the attribute)* equally applies to this section and should be consulted.

2.4.2 Setting a target

In principle, the target should be set at no loss in extent of the sub-feature or representative/notable biotope during the monitoring cycle. Expert judgement will be necessary to determine whether any deviation from baseline is considered unfavourable. It may be necessary to set a target that declines each monitoring cycle where there is an established natural loss of extent, or sufficient data available to predict (via a model) a downward trend in extent. Departure from this predicted target then would be a trigger for investigation and the feature may be considered unfavourable.

Extent can be measured in absolute terms, using an index approach such as point sampling over a grid, or by inference. The type of measure used should be linked to the known or likely threats posed by anthropogenic activities and take into account natural variation in extent or in cyclical succession between biotopes. The target needs to identify biotopes that would be expected to be part of that natural cycle.

Information from aerial photographs and biotope maps can be used to highlight areas that are of interest within the feature. It is expected that the target for the attribute would be given in hectares or square metres and not to decline from this baseline unless due to natural processes.

The following issues should be considered:

- The number of representative/notable biotopes present within the assessed feature.
- The natural "cyclical partners" for the identified biotopes must be listed with the target.
- Check that all aerial photographs and broadscale maps have the same upper and lower boundaries, are at the same scale and to the same datum.

An example of how a target for this attribute might be expressed is shown in Box 5.

Box 5A site-specific target for the attribute "Extent of sub-feature or representative/ notable biotope"

Target	Comments
Extent of the biotopes should not deviate from an established baseline (e.g. Titley et al. 1998) subject to natural change. MLR.R.Mas- At Thanet, this biotope is dominated by *Chondrus* which grows over piddock bored rock. MLR.R.Osm MLR.R.Pal- Much of this biotope at Thanet occurs over piddock- or *Polydora*- bored chalk. MLR.R.XR.- Much of this biotope at Thanet occurs over piddock- or *Polydora*- bored chalk. MLR.R.Rpid MLR.Eph.Rho- Grows on piddock-bored chalk on Thanet with *Rhodothamniella* forming often dense mats. MLR.BF.FserR- Mixed fucoids and red algal turfs, also occurs over piddock-dominated rock.	The extent of the sub-feature or representative notable biotopes listed are an important structural aspect of the sub-feature and therefore the littoral and inshore sublittoral rock habitats. Changes in extent and distribution may indicate long-term changes in the physical conditions at the site.

*Taken from Thanet Coast cSAC

2.4.3 Suggested techniques

The Marine Monitoring Handbook (Davies *et al.*, 2001) contains details of the techniques appropriate for monitoring the condition of designated features.

Possible methods provided in the handbook for measuring the extent of sub-feature or representative or notable littoral and inshore sublittoral rock biotope(s) are:

- 3-1 *In situ* intertidal biotope recording (grid sampling using effort-limited biotope identification techniques) this will give a non-continuous measure, but is only appropriate for extensive biotopes. A transect sampling strategy with direct observation is appropriate for biotopes with limited spatial extent.

Other proposed methods, not as yet detailed in the handbook are:

- Satellite and airborne multi-spectral remote sensing, which will provide a continuous measure of extent if the sensor can resolve the biotope.

2.5 Presence of representative/ notable biotopes

Presence of representative/ notable biotopes is considered a site-specific attribute to assess the overall conservation value of a site to highlight local distinctiveness and therefore may not be applicable to all sites.

2.5.1 Background to the attribute

This attribute should be used where the continued presence of a single, or small number of discrete biotopes, is fundamental to the maintenance of favourable condition of the overall rock feature. The biotope(s) selected may be notable (i.e. of significant conservation value), highly representative of the rocky communities present within the site or serve an important role in the structure and function of the wider rock feature. In all cases the loss of the biotope(s) specified should represent a loss of the conservation interest of the site because if the attribute fails to meet the target specified, this will render the condition of the rock feature unfavourable.

The issues described under *Biotope composition* in relation to specifying biotopes equally apply this attribute. Unlike *Biotope composition*, which serves as a measure of the biological diversity within a site (expressed in terms of numbers of different biotopes) this attribute is concerned solely with the continued presence of the target biotope(s) and as such will have very clear pass/ fail criteria.

An example of the distinction between these attributes can be demonstrated using Loch Creran cSAC as an example. This site on the West Coast of Scotland supports internationally important biogenic reefs, composed of dense aggregations of calcareous sepulid worm tubes. The serpulid worm *Serpula vermicularis* responsible for forming these reef structures is found throughout the UK but the dense 'reef' type aggregations (assigned the very rare biotope CMS.Ser - *S. vermicularis* reef on very sheltered circalittoral muddy sand) are restricted to this single site in the UK and a couple of sites in Co. Galway, Republic of Ireland. The selection of an attribute that requires the maintenance of the CMS.Ser biotope within Loch Creran cSAC would clearly be more appropriate than a species level attribute that required only the continued presence of *S. vermicularis*.

The resolution to which biotopes are expressed in the target will have to be considered with regard to their use in condition assessment. It may be appropriate to use higher level biotopes (e.g. biotope complexes) in preference to the more detailed ones that are difficult to identify in the field. However, it may be that it is the lower level biotopes that are considered 'notable' and hence require to be maintained.

It is important to understand cyclical succession of biotopes. Biotopes are often defined by differing abundance of species, and under natural conditions certain biotopes will cycle about each other, and may disappear and reappear over time. These cycles are an acceptable part of the interest of the feature and must be considered when specifying biotopes and phrasing target values (see Section 2.5.2). A suite of the biotopes expected at the site should be listed with their "cyclical partners".

Where the field assessment judges the observed changes to the specified biotope(s) to be unfavourable, and subsequent investigation reveals the cause is clearly attributable to cyclical natural processes (e.g. dieback of characterising species or acceptable biotope "cycling"), the final assessment will require expert judgement to determine the reported condition of the feature. The feature's condition could be declared favourable where the officer is certain that the conservation interest of the feature is not compromised by the failure of this attribute to meet its target condition. Where there is a change outside the expected variation or a loss of the conservation interest of the site, (e.g. due to anthropogenic activities or unrecoverable natural losses) then condition should be considered unfavourable.

2.5.2 Setting a target

The biotope(s) to be assessed must be clearly specified and its/their presence within the site derived from biotope maps or from other more detailed survey records. Targets should be set that require the determination of the presence of the named biotope(s) from selected areas within a site over the monitoring cycle (sampling locations are also likely to be governed by access and health and safety

issues[8]). It is important that the targets and measures set are clear and unambiguous. The targets and measures should determine the resolution (i.e. whether the assessment is based on biotope complex, biotope or sub-biotope level) and the scale of the assessment (i.e. intensity of sampling). The targets should also clearly identify what must be achieved in order to pass or fail (i.e. biotope X must be present within the feature).

The general points described under *Biotope composition* in relation to defining a target for littoral and inshore sublittoral rock habitats equally apply to this attribute.

An example of how a target for this attribute might be expressed is shown in Box 6.

Box 6A site-specific target for the attribute "Presence of representative/notable biotopes"

Target	Comments
Presence of the limestone biotopes SubSoAs and AlcByH.Hia, (checked during the summer, once during reporting cycle) should not deviate significantly from the established baseline, subject to natural change.	The biotopes SubSoAs and AlcByH.Hia are key structural components of the subtidal limestone and are of particular nature conservation importance due to the unusual physical conditions. These biotopes have species rich communities that contribute to the structure of the inshore sublittoral rock communities.

*Taken From Flamborough Head cSAC

2.5.3 Suggested techniques

It is likely that emphasis will be placed on assessing the continued presence of those biotopes of greatest conservation value. Within some sites these biotopes may be clumped disproportionately within a small section of a larger site. Ideally, a mapping or inventory study of all rocky biotopes would be undertaken to provide baseline information to properly phrase the measure and targets for this site-specific attribute. Such a study would also guide more detailed targeted studies to assess biological quality within specified biotopes (e.g. species composition attributes).

The Marine Monitoring Handbook (Davies *et al.*, 2001) contains details of the techniques appropriate for monitoring the condition of designated features.

Possible methods provided in the handbook for assessing the presence of representative/ notable biotopes of intertidal rocky habitats are:

- 1-1 Intertidal resource mapping using aerial photographs.
- 1-2 Fixed viewpoint photography.
- 3-1 *In situ* intertidal biotope recording (transect sampling and grid sampling strategies)
- 3-2 *In situ* survey of intertidal biotopes using abundance scales and checklists at exact locations (ACE surveys) (transect sampling and grid sampling strategies)

Possible methods provided in the handbook for assessing the presence of representative/ notable biotopes of subtidal rocky habitats are:

- 3-5 Identifying biotopes using video recordings
- 3-13 *In situ* surveys of sublittoral epibiota using hand-held video.
- 3-14 *In situ* survey of sublittoral epibiota using towed sledge video and still photography.

[8] Information on health and safety issues can be obtained in the Marine Monitoring Handbook **http://www.jncc.gov.uk/marine** or from appropriate country agency risk assessments.

Other proposed methods, not as yet detailed in the handbook are:

- 3-4 Descriptive and quantitative surveys using remote operated vehicles (ROV)

2.6 Species composition of representative or notable biotopes

Species composition of representative or notable biotopes is considered a site-specific attribute used to highlight local distinctiveness when assessing the overall conservation value of a site and may therefore not be applicable to all sites.

2.6.1 Background to the attribute

Species composition is an important contributor to the structure of a biotope. A determination of species composition gives an indication of the quality of the biotope, and a change in composition may indicate a cyclic change/trend in communities.

Any change in species populations should be assessed as an overall measure of community structure of the biotope rather than as an individual or indicator species. An assessment of species composition may be restricted to measure only the characterising species of a targeted biotope where the overall species composition of that biotope is poorly understood and subject to measurement error. These species can be identified from the MNCR biotope classification using species with a typical abundance of common or above (using SACFOR abundance scale from MNCR classification). The target should include a list of these characterising species.

Where a change in species composition is clearly attributable to natural succession and known cyclical change such as mass recruitment and dieback of characterising species, then this should be reflected in the target. The feature's condition could be declared favourable where the officer is certain that the conservation interest of the feature is not compromised by the failure of this attribute to meet its target condition. Where there is a change in species composition outside the expected variation or a loss of the conservation interest of the site, (e.g. due to anthropogenic activities or unrecoverable natural losses) then condition should be considered unfavourable.

2.6.2 Setting a target

Species composition can be measured in absolute terms (number of species, density of a species), using an index (evaluating the overall number of species even if exact species compliment changes) or in terms of presence/absence. The type of measure will depend on the context in which the attribute is used.

The following issues should be considered:

- The biotope for which a species composition measure is required must be clearly stated in the attribute table and identifiable in the field.
- Biotopes may be selected for different reasons, for example their overall diversity or because they contain species of conservation importance. The reason for selection will determine what species should be measured and hence the way a target is phrased.
- It may be appropriate to select a subset of the species present, avoiding species whose presence is ephemeral, difficult to sample or difficult to identify.
- It may be appropriate to develop a checklist of species for a biotope, for example those species that make important structural and functional contributions to the biotope's continued existence.
- For biotopes that have a high turnover of species, it is more appropriate to use an index measure, although careful consideration must be given to the actual measure. Note, indices have specific requirements in terms of the type of data used and its method of collection.

- Species selected could be: nationally rare or scarce; species that have an important functional or structural role in the feature; species indicative of the 'health' of the feature; species indicative of the level of anthropogenic activity; non-native species (where their presence is considered unfavourable).
- Species targets could be derived from existing records for that biogeographic region.
- Careful consideration must be given to the use of species that are known to have a high turnover or fluctuation in abundance.
- Species recording has significant quality assurance issues in relation to the sampling methodology and particularly the taxonomic competence of the recorders. It may therefore be appropriate to select species that are capable of a relatively simple assessment. If necessary a pre-assessment visit may help to identify or check the ease of recording. Target condition should be established with regard to these QA issues.

An example of how a target for this attribute might be expressed is shown in Box 6.

Box 6 A site-specific target for the attribute 'Species composition of representative or notable biotopes'

Target	Comments
No decline in quality (presence and abundance) of rockpool biotopes LR.Rkp.COR, LR.Rkp. COR. BIF and LR.Rkp.FK due to change in species composition or loss of notable species, allowing for natural succession/known cyclical change.	LR.Rkp.COR, LR.Rkp. COR. BIF and LR.Rkp.FK abundance* assessed against MNCR data *This attribute will require specialist information and the results will need to be provided to conservation officers before the site unit can be assessed.

2.6.3 Suggested techniques

Most assessments of species composition will require quantitative measurements of the species present and/or their abundance within a defined area. Such measurements should be undertaken at a number of stations throughout the feature and **will require specialist taxonomic expertise.** It may be appropriate to employ fixed stations, although there may be additional overheads for maintenance of the fixings and/or site markings. Imaging techniques are only appropriate where the representative or otherwise important species can be reliably identified from the image.

The Marine Monitoring Handbook (Davies *et al.*, 2001) contains details of the techniques appropriate for monitoring the condition of designated features.

Possible methods of assessing the species composition of littoral rock habitats are quantitative sampling (for example using quadrats) or Phase II survey supplemented with intertidal photography at specific/designated stations. Possible methods provided in the handbook are:

- 3-1 *In situ* biotope recording
- 3-2 *In situ* survey of intertidal biotopes using Abundance scales and Checklists at Exact locations (ACE).
- 3-11 littoral monitoring using fixed quadrat photography

Possible methods of assessing the species composition of sublittoral rock habitats are quantitative sampling using subtidal quadrat sampling; subtidal photography (including ROV & diver operated video); suction sampling. Possible methods provided in the handbook are:

- 3-7 *In situ* quantitative survey of subtidal epibiota using quadrat sampling techniques
- 3-10 Sampling marine benthos using suction samplers
- 3-13 *In situ* surveys of sublittoral epibiota using hand-held video

Other proposed methods, not as yet detailed in the handbook are:

- Descriptive and quantitative surveys using remote operated vehicles (ROV)

2.7 Presence and/or abundance of specified species

Presence and/or abundance of specified species is considered a site-specific attribute used to highlight local distinctiveness when assessing the overall conservation value of a site and may therefore not be applicable to all sites. Species selected should reflect the specific biological characteristics of the designated site.

2.7.1 Background to the attribute

The species selected should serve an important role in the structure and function of the biological community. The method for measurement will vary, depending on the species and how it is contributing to the structure and function of the littoral and inshore sublittoral rock habitats. Changes in presence and abundance of a species can critically affect the physical and functional nature of littoral and inshore sublittoral rock habitats, leading to unfavourable condition.

Where the field assessment judges changes in the presence and/or abundance of specified species to be unfavourable, and subsequent investigation reveals the cause is clearly attributable to cyclical attributable to natural succession and known cyclical change such as mass recruitment and dieback of characterising species, the final assessment will require expert judgement to determine the reported condition of the feature. The feature's condition could be declared favourable where the officer is certain that the conservation interest of the feature is not compromised by the failure of this attribute to meet its target condition. Where there is a change outside the expected variation or a loss of the conservation interest of the site, (e.g. due to anthropogenic activities or unrecoverable natural losses) then condition should be considered unfavourable.

Where a notable negative indicator species has been identified, then a target should be set to trigger more frequent monitoring. If the indicator is having a detrimental effect on a biotope of nature conservation importance then the attribute should be recorded as unfavourable.

There is a variety of additional attributes based on the presence and/or abundance of species (one or many) that may be used properly to represent the special nature of a feature on a site. Examples include:

- the presence and/or abundance of a notable species that is nationally scarce or nationally rare
- the age structure of a species population such as *Modiolus modiolus*, indicative of the vitality of a biogenic mussel reef
- the density of kelp species - an important measure of the functional component of some infralittoral rock communities
- the presence of an invasive non-native species such as *Sargassum muticum*, that may lead to the feature being deemed in unfavourable condition.

2.7.2 Setting a target

Presence or abundance of specified species can be measured in absolute terms (numbers of species, density of species), using an index or in terms of presence/absence. The type of measure will depend on the context in which the attribute is used.

The following issues should be considered:

- The species for which the attribute measure is required must be clearly stated in the attribute table and identifiable in the field.

- The reason for selection will determine what should be measured and hence the way a target is phrased. A target of “maintain presence and/or abundance of the named species” should be used where the species is providing a structural/functional role within the habitat.
- Characterising species should be apparent from the site documentation, the SSSI citation or previous surveys. These species could be: nationally rare or scarce; species that have an important functional or structural role in the feature; species indicative of the 'health' of the feature; species indicative of the level of anthropogenic activity; non-native species (where their presence is considered unfavourable).
- Species targets could be derived from existing records for that biogeographic region.
- Careful consideration must be given to the use of species that are known to have a high turnover or fluctuation in abundance.
- Species recording has significant quality assurance issues in relation to the sampling methodology and particularly the taxonomic competence of the recorders. It may therefore be appropriate to select species that are capable of a relatively simple assessment. If necessary a pre-assessment visit may help to identify or check the ease of recording.

An example of how a target for this attribute might be expressed is shown in Box 7.

Box 7 A site-specific target for the attribute *Presence and/or abundance of specified species*

Target	Comments
More than 30 % cover of *S. muticum* (Japweed) in 50 % of a representative series of rockpool biotopes LR.Rkp.COR, Lr.Rkp.Cor.Bif and LR.Rkp.FK, observed on structured walk(s).	Increased *Sargassum* is believed to compete with native species and would thus be detrimental to favourable condition.

2.7.3 Suggested techniques

Possible methods for assessing the presence and/or abundance of specified species are quantitative sampling techniques to enumerate presence and quantity of individuals. Remote observation using video may be possible if the camera can reliably identify the species.

Measuring techniques are the same as those listed previously for the species composition attribute and often their deployment strategy will facilitate the measurement of data for multiple species attributes during a single recording event.

The Marine Monitoring Handbook (Davies *et al.,* 2001) contains details of the techniques appropriate for monitoring the condition of designated features.

3 Other environmental and physical parameters

Although condition assessment will look at attributes within the condition tables, in some cases the results may be difficult to interpret without some additional evidence in the form of data on environmental and physical parameters. Environmental and physical parameters are considered to be site-specific and should only be used as supporting information to highlight local distinctiveness when assessing the overall conservation value of a site, where they are considered to be fundamental to the condition of the feature. For example, an attribute measuring water clarity may be considered where a decline may result in reduction of quality of algal assemblages in the feature.

It should be emphasised that if an attribute for an environmental or physical parameter is selected as part of the definition of favourable condition for the feature, it must be considered during the assessment process. It is therefore essential that a realistic target can be established, taking account of

known inherent variation, and a reliable method of measurement is available, since a failure to meet the target condition will render the condition of the feature unfavourable.

The following parameters, from which site-specific attributes may be derived, are known to influence the status of littoral and inshore sublittoral rock habitats and/or their associated communities. This is not an exhaustive list and additional parameters may be appropriate, taking into consideration the comments in the preceding paragraph on the need for a strong justification for an attribute's use in condition assessment.

It will be necessary to relate any local measurements of physical parameters to contextual information for a wider geographical area when interpreting the data. Local changes may reflect a regional trend rather than any site-based anthropogenic activity and judgement needs to be made whether or not extra environmental attributes are needed. It may be necessary to seek expert advice.

3.1 Water clarity

Algal communities normally occur on inshore sublittoral rock to a depth where light availability equates to approximately 1% of surface irradiance. This depth limit varies around the UK coast as a result of local factors such as the discharge from turbid estuaries (e.g. the Severn), the presence of adjacent sedimentary shores or shallow sublittoral sediment habitats, and eroding cliffs. Anthropogenic activity that results in a reduction in water clarity, for example the disposal of dredge spoil or demersal fishing activity, may lead to a reduction in the lower depth limit and/or the composition of algal assemblages. Such changes are only likely to occur if water clarity is reduced over an extended period of time (months to years), and particularly during the late spring and early summer growth phase of algal communities.

3.2 Water Density (salinity regime and temperature)

Temperature and salinity are characteristic of the overall hydrography of the area. Any changes in the prevailing temperature and salinity regimes may affect the presence and distribution of species (along with recruitment processes and spawning behaviour).

Where changes in temperature or salinity through adverse impacts e.g. thermal discharge plumes, industrial discharges, water abstraction etc. cause a severe loss or shift in community structure such that the conservation interest is adversely affected then condition should be judged as unfavourable. Where changes in temperature or salinity are due to natural processes such as severe winter temperatures, then this will be an acceptable change to the feature.

3.3 Sedimentation Rate

Where adverse anthropogenic impacts such as dredging, disposal of dredge spoil or changed water flows due to artificial structures cause a change in sedimentation rate leading to severe smothering of the rock habitat, or a adverse shift in community structure, then condition should be judged as unfavourable. Where changes in sedimentation rate are attributable to natural processes such as storm events, changed tidal movements or dynamics, or natural erosion, then this will be an acceptable change to the feature unless the conservation interest is lost.

Biogenic reefs constructed by the polychaete worm *Sabellaria* spp. rely on an adequate supply of sediment of the correct size fraction to enable the worms to construct their tubes. An interruption to the sediment supply regime may reduce the tube-building activity and thereby compromise the structure of the biogenic reef.

3.4 Suggested techniques

Routine measurement is required to determine temporal trends where the frequency will depend on the characteristic in question. Remote measurement and data logging devices will most likely be required to sample efficiently at an appropriate frequency.

Lack of surveillance of physical attributes during a monitoring cycle will mean that any changes noted by the biological monitoring are likely to provide inadequate evidence to assess whether the change is

natural or anthropogenic. Some changes in biology may be large but not part of a natural cycle and this can only be assessed if there is adequate surveillance of certain physical attributes and any significant anthropogenic threats.

4 Recommended visiting period and frequency of visits

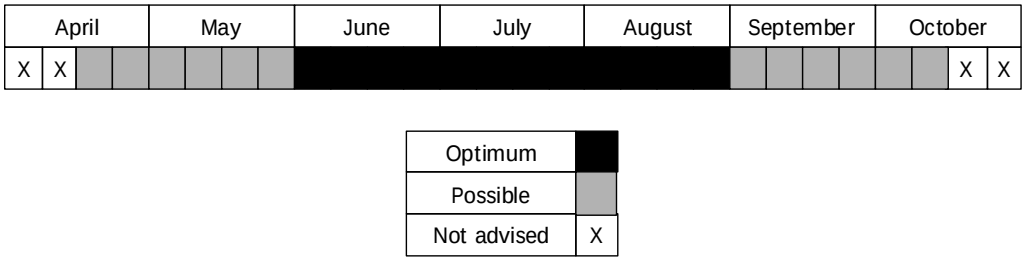
4.1 Seasonal effects

Marine communities exhibit seasonal change, although the precise effects are poorly understood for many communities. Some of the more obvious visual changes occur in algal assemblages, and following massive settlements of juvenile animals such as mussels and barnacles. In Loch Maddy cSAC, a recent study concluded that the largest changes observed in shallow communities between autumn 1998 and summer 1999 were due to an increase in diversity and abundance of algae (Howson & Davison, 2000). Similarly, in Plymouth Sound cSAC, most of the changes observed between 1998 and 1999 were attributed to real changes in populations, rather than variability in recording methods or behavioural factors (Moore, 2000). The degree to which seasonal change will influence the monitoring of littoral and inshore sublittoral rock attribute will depend on the community under investigation. Where possible, a community should be investigated either directly or via a literature review to gather information on the likelihood of seasonal change affecting an attribute. In general, algal assemblages should be studied during the summer months. Where seasonal effects are not fully understood, it is vital that a monitoring strategy explicitly states that data collection must always be undertaken at the same time of year[9].

Whilst seasonal variation strictly relates to changes within a year, epibenthic communities may change over a longer time period (many years) as a consequence of ecological processes affecting community dynamics. Physical and biotic processes can cause wholesale changes in community composition on littoral and inshore sublittoral rock habitats. Community dynamics of rock shores have been extensively investigated and many authors report cyclical changes in the community composition over time (Menge, 1995; Hartnoll & Hawkins, 1980). Clearly, not considering such changes when interpreting the results of a monitoring exercise or when setting targets would lead to incorrect conclusions.

4.2 Time of assessment

Recommended timing for survey (months – weeks)



4.3 Meteorological changes

Benthic organisms are adapted to the incident environmental conditions, particularly salinity, wave exposure, tidal stream strength, temperature and tidal ranges. Extreme events affecting any of these factors can have major effect on the benthic community composition.

Storm events can have a massive effect on marine communities through the removal of species either by direct abrasion, or through damage from wave-borne debris (e.g. logs, rocks, sand etc.). This episodic removal of species allows for a succession of marine communities from the ephemeral, fast

[9] See Section 2 of the Marine Monitoring Handbook (**http://www.jncc.gov.uk/marine**)

growing to the eventual re-establishment of a stable community, the composition of which will be influenced by the supply of available larvae at that time. Storm events will have a profound effect on intertidal and shallow subtidal communities, but have a lesser effect on the deeper circalittoral benthic communities. Storm events can also mobilise sediment adjacent to the rock thereby reducing water clarity and reducing the light available for algal growth.

Marine organisms are tolerant of fluxes in temperatures, however temperature extremes can devastate species populations in the intertidal and shallow subtidal. Extremely cold temperatures can freeze organisms and excessively hot temperatures can cause desiccation of organisms and bleaching of marine algae. Both stresses can cause mass mortality in marine organisms.

The UK sits on a biogeographic boundary between warm waters to the south and west and cold, arctic influenced waters to the north and east. This is reflected in the distribution of some benthic species that reach their northern/southern limit around the UK coastline. Seawater temperatures are changing in response to climate change, which will affect the relative abundance and range of species present, allowing warm water species to advance north, and out-competing the colder water species (Hawkins *et al.*, 2001).

5 Additional information

5.1 Planning a sampling programme

The whole feature must be considered when planning a sampling programme. Clearly, this poses considerable logistical problems when dealing with very extensive sites particularly where the rock habitat extends from the top of the intertidal zone through to the deep circalittoral zone. A monitoring strategy will need to encompass techniques to consider broad-scale, whole feature attributes and some detailed sampling to assess the biological quality (Wyn & Kay, 2000). Broad-scale maps can provide both data for the whole feature (*Extent, Biotope distribution*) and the necessary information to apply a stratified sampling programme, to select a few locations to be investigated in detail and the results extrapolated to the whole site. Nevertheless, the sampling strategy should include a series of ‘spot checks’ throughout the site to ensure that the extrapolated results are in fact representative of the condition of the entire site.

To gain access to the site, the surveyor must consider the issues of permission (intertidal sites), tidal state (high or low water/slack water), prevailing wind/wave/swell conditions and underwater visibility. Access to intertidal habitats would be gained from the land, except for islands and offshore banks or remote sites where boat access will be needed. It will be necessary to use a boat to gain access to many subtidal rocky habitats and therefore it will be necessary to consider the availability of harbours and/or launching facilities. Land access would be possible for those subtidal habitats immediately adjacent to the shore.

DGPS (Differential Global Positioning System) should be used for recording position on extensive littoral rock and inshore sublittoral rock habitats. Photographs and/or diagrams of characteristic topographical features to find the precise location of a site marker should supplement maps. For subtidal sites, the approximate position can be located using conspicuous land features, preferably lined up to create transits. Photographs and/or diagrams should be used underwater to find the precise sample location although poor visibility creates severe problems.

5.2 Health and safety

All fieldwork must follow approved codes of practice to ensure the health and safety of all staff. Intertidal rocky habitats often have complex topography that, when combined with a covering of algae, create an uneven slippery surface. Considerable care must be taken to reduce the risk of staff slipping or falling, particularly in remote areas where tidal immersion could occur before emergency assistance arrives. Field staff should take appropriate safety equipment, such as carry a radio or mobile telephone to ensure the emergency services are notified promptly.

Some subtidal sampling will involve SCUBA diving techniques. All diving operations are subject to the procedures described in the Diving at Work Regulations 1997[10] (see: **http://www.hse.gov.uk/lau/lacs/47-11.htm**) and must follow the Scientific and Archaeological Approved Code of Practice[11] (see **http://www.hse.gov.uk/diving/osd/part.htm#Scientific**).

Risks specific to working on littoral rock and inshore sublittoral rock habitats are detailed in the Marine Monitoring Handbook (Davies *et al.* 2001), the NMMP's Green Book[12] and references therein.

[10] The Diving at Work Regulations 1997 SI 1997/2776. The Stationery Office 1997, ISBN 0 11 065170 7.

[11] Scientific and Archaeological diving projects: The Diving at Work Regulations 1997. Approved Code of Practice and Guidance – L107. HSE Books 1998, ISBN 0 7176 1498 0.

[12] See **http://www.cefas.co.uk/monitoring/page-b3.asp** for information on the NMMP and for the NMMP Green book **http://www.marlab.ac.uk/FRS.Web/Uploads/Documents/GBMain%20Text%201103.pdf**.

6 Generic attributes table

The following table lists the generic attributes that should be used to define the condition of littoral rock and inshore sublittoral rock features.

For details of assessment techniques see Section 2 and Davies *et al*., 2001.

Table 1. UK GUIDANCE ON CONSERVATION OBJECTIVES FOR MONITORING DESIGNATED SITES

Interest feature: Littoral rock and inshore sublittoral rock

Equivalent Phase 1 category: H1.3 Intertidal boulders/rocks, K Marine (part)

Includes the Habitats Directive Annex I habitat types: H1170 **Reefs**, H8330 **Submerged or partially submerged sea caves**, H1130 **Estuaries** (in part) and H1160 **Large shallow inlets and bays** (in part).

Reporting categories: Littoral rock/Inshore sublittoral rock

NOTE: The attributes apply to all sites with littoral rock and inshore sublittoral rock features <u>except</u> those with asterisks which may <u>not</u> be applicable to all sites, and should be selected <u>only</u> where they reflect the conservation interest of the individual site.

It is essential that the section in the marine introductory text entitled *Setting objectives and judging favourable condition* is read in conjunction with this table when selecting the attributes to judge the condition of the feature.

Attribute	Target	Method of assessment	Comments
Extent	No change in extent of littoral rock and inshore sublittoral rock	Extent should be assessed periodically against a baseline map/aerial image or through the review of any known activities that may have caused an alteration in extent. For details of assessment techniques see Section 2 and Davies *et al*., 2001.	It may be necessary to set a target that declines each monitoring cycle where there is an established natural loss of extent, or sufficient data available to predict (via a model) a downward trend in extent. Departure from this predicted target then would be a trigger for investigation and the feature may be considered unfavourable. Where the field assessment judges extent to be unfavourable, and subsequent investigation reveals the cause is clearly attributable to cyclical natural processes, the final assessment will require expert judgement to determine

Attribute	Target	Method of assessment	Comments
			the reported condition of the feature. The feature's condition could be declared favourable where the officer is certain that the conservation interest of the feature is not compromised by the failure of this attribute to meet its target condition. Changes in extent would be considered unfavourable if attributable to activities which interrupt natural coastal processes such as coastal protection schemes or coastal development.
Biotope composition of the littoral rock and inshore sublittoral rock	Maintain the variety of biotopes identified for the site, allowing for natural succession or known cyclical change.	Repeated assessment of overall biotope composition or a subset of specified biotopes identified for the site. For details of assessment techniques see Section 2 and Davies *et al*., 2001.	Where changes in biotope composition are known to be attributable to natural processes (e.g. winter storm/flood events, changes in supporting processes or mass recruitment or dieback of characterising species) then the target value should accommodate this variability. Where there is a change in biotope composition outside the expected variation or a loss of the conservation interest of the site, then condition should be considered unfavourable.
Distribution of biotopes Spatial arrangement of biotopes at specified locations	Maintain the distribution and/or spatial arrangement of biotopes, allowing for natural succession/known cyclical change	Assess the geographic distribution of specified biotopes identified for the site. Assess the zonation pattern or the juxtaposition of specified biotopes. For details of assessment techniques see Section 2 and Davies *et al*., 2001.	Where changes in distribution/spatial pattern are known to be clearly attributable to cyclical succession or an expected shift in distribution then the target value should accommodate this variability. Where there is a change in biotope distribution/spatial pattern outside the expected variation or a loss of the conservation interest of the site, then condition should be considered unfavourable.
*Extent of sub-feature or representative /notable	No change in the extent of the biotope(s) identified for the site allowing for natural	Assessment of the extent of (a) biotope(s) identified for the site due to their nature conservation importance. For details of assessment techniques see Section 2 and Davies *et al*., 2001.	Where there is natural variation in extent or in cyclical succession between biotopes, then the target value should accommodate this variability. The target needs to identify biotopes that would be expected to be part of that natural

Attribute	Target	Method of assessment	Comments
biotopes	succession/ known cyclical change.		cycle. Where there is a change in extent outside the expected variation or a change in the structure of the sub-feature leading to a loss of the conservation interest of the site, then condition should be considered unfavourable.
*Presence of representative / notable biotopes	Maintain the presence of the specified biotope allowing for natural succession/ known cyclical change.	Assess the presence of named biotopes. For details of assessment techniques see Section 2 and Davies *et al*., 2001.	Biotopes selected should reflect the specific biological characteristics of the designated site. Where there is natural variation in, or cyclical succession between biotopes, then the target value should accommodate this variability. The target needs to identify biotopes that would be expected to be part of that natural cycle. Where there is a change outside the expected variation or a change in the structure of the sub-feature leading to a loss of the conservation interest of the site, then condition should be considered unfavourable.
*Species composition of representative or notable biotopes	No decline in biotope quality due to change in species composition or loss of notable species allowing for natural succession/ known cyclical change.	Assessment of biotope quality through assessing species composition where the biotope is representative of the site, or contains a number of species of conservation importance. For details of assessment techniques see Section 2 and Davies *et al*., 2001. Assessing this attribute will require specialist taxonomic expertise.	Where changes in species composition are known to be clearly attributable to natural succession, known cyclical change or mass recruitment or dieback of characterising species, then the target value should accommodate this variability. Where there is a change in biotope quality outside the expected variation or a loss of the conservation interest of the site, then condition should be considered unfavourable.
*Presence and/or abundance of specified	Maintain presence and/or abundance of the specified species.	Assessment of the presence/absence or abundance of a specified species identified for the feature. For details of assessment techniques see Section 2 and Davies *et al*., 2001.	Species selected should reflect the specific biological characteristics or key conservation interest of the designated site. Where a change in presence and abundance of specified

Attribute	Target	Method of assessment	Comments
species	Absence of the specified species (such as an undesirable non-native species)		species is known to be clearly attributable to natural succession then the target value should accommodate this variability. Where there is a change in biotope quality outside the expected variation or a loss of the conservation interest of the site, then condition should be considered unfavourable.

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