Common Standards Monitoring Guidance

for

Sea Caves

Version August 2004

Updated from (February 2004)

ISSN 1743-8160 (online)

Common standards monitoring guidance for Sea Caves

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 cave guidance when setting attributes.

1 Definition of Sea caves

Caves can vary in size, from only a few metres to more extensive systems, which may extend hundreds of metres into the rock. No definition for caves states what the lower size limit is for a cave, there may be tunnels or caverns with one or more entrances, where vertical and overhanging rock faces provide the principal marine habitat, large overhangs, blowholes that include enclosed fully shaded areas and archways that support 'cave' biotopes. At which point does a large crevice or overhang count as a cave? For the purposes of a survey, a pragmatic approach must be adopted and a cave must be large enough to get a surveyor fully into the cave, turn round and exit without damaging the attached flora and fauna (Bunker & Holt, 2003).

A high proportion of sea caves is found in the intertidal or in shallow water. Caves on the shore and in the shallow sublittoral zone are frequently subject to conditions of strong wave surge and tend to have floors of coarse sediment, cobbles and boulders. These materials are often highly mobile and scour the cave walls. Physical conditions, such as inclination, wave surge, scour and shade, change rapidly from cave entrance to the inner parts of a cave and this often leads to a marked zonation in the communities present. Caves are typically colonised by encrusting animal species but may also support shade-tolerant algae near their entrances.

Sea caves around the UK coast display a wide range of structural and ecological variation, depending on the prevailing physical and geological conditions. Cave systems, with extensive areas of vertical and overhanging rock, and those that extend deeply into the rock, generally support the widest range and highest diversity of plants and animals.

Box 1 "Sea Caves" includes the following habitat types:

Habitats Directive	BAP Broad habitat type[1]	BAP Priority habitat/Action Plan1	OSPAR Threatened Habitat[2]
Submerged or partially submerged sea caves	Littoral rock Supralittoral rock Inshore sublittoral rock	Littoral and sublittoral chalk	

A condition assessment of submerged or partly submerged sea caves should be based on the attributes[3] and their associated targets derived from Table 1 in Section 5. This lists the generic attributes that are considered most likely to represent the condition of the feature. It will be necessary to develop a site-

[1] 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

[2] 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.

[3] 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*.

specific expression of some or all of these generic attributes to properly represent the conservation interest of the feature and fully reflect any local distinctiveness.

2 Background, targets and monitoring techniques for individual attributes

Many cave attributes are similar to those for littoral rock and inshore sublittoral rock. This guidance should be read in conjunction with the prepared guidance on littoral rock and inshore sublittoral rock for information on the background to these selected attributes.

NOTE: All the attributes are currently deemed discretionary until further field survey provides sufficient data to formulate advice on those attributes which apply to all sites. An attribute should only be selected where it reflects the conservation interest of the individual feature on a site.

2.1 Extent of cave(s)

Extent is interpreted in terms of the dimensions of the caves(s). The extent of the cave is likely to fluctuate over time through erosion or collapse, particularly in ‘soft rock’, but nevertheless needs to be measured periodically.

2.1.1 Background to the attribute

Caves can vary in size, from only a few metres to more extensive systems, which may extend hundreds of metres into the rock. No definition for caves states what the lower size limit is for a cave, there may be tunnels or caverns with one or more entrances, where vertical and overhanging rock faces provide the principal marine habitat, large overhangs, blowholes that include enclosed fully shaded areas and archways that support ‘cave’ biotopes. At which point does a large crevice or overhang count as a cave? For the purposes of a survey a pragmatic approach must be adopted and a cave must be large enough to get a surveyor fully into the cave, turn round and exit without damaging the attached flora and fauna (Bunker & Holt 2003).

For measuring and recording cave dimensions a systematic approach is required to ensure that all the necessary information is obtained. Dimensions such as the depth, wall height, floor width and bearings across the floor may be useful measurements.

Caves are highly dynamic and their extent is likely to fluctuate over time, particularly in friable rock where erosion or collapse processes are likely to occur. Where extreme natural events (such as severe storm damage leading to a cave collapsing) cause a substantial loss of extent of the feature, then this would be considered unfavourable.

Where changes in the extent of caves are deemed to be attributable to physical damage as a result of anthropogenic activity, by processes such as increased siltation, abrasion or selective extraction of animals or plants, then this would cause the attribute to be judged as unfavourable.

2.1.2 Setting a target

In principle the target should be that the extent of cave features has not diminished: the volume, vertical and lateral extent of the features must be within their normal natural range[4].
The specific measure used will depend on the cave itself, but will normally relate to the linear extent and a measure of height and/or width at pre-determined points. It does not necessarily mean a 3D dimension.

[4] refer to “earth science site monitoring guidance – common standards”

Alternatively, the cave type could be classified in terms of its morphology. A list of categories has been proposed by CCW and will be included in this guidance when it becomes available.

When setting a target it is important to note that there are 2 levels to which extent should be considered. These are:

- Extent of a suite of caves, which are to be maintained within a whole site
- Dimensions of a specific cave identified as being of conservation interest.

Issues which need to be considered include:

- rock/sediment removal from caves
- addition of rock/sediment/soil/scree to the cave system
- redistribution of sediments within the cave site
- change in water flow regime through the cave.

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 of caves'

Target	Comments
No reduction in extent (cave dimensions) from Howson (2000). Sea cave site 5 dimensions: Length = 2.3m Height = 1.1m Width = 3m	Condition would be judged unfavourable if loss in extent is due to factors other than natural processes that are part of a wider coastal geomorphological management regime. See Howson (2000) for sea cave dimensions for Flamborough Head cSAC. This report provides the baseline. Where extreme natural events (such as severe storm damage leading to a cave collapsing) cause a substantial loss of extent of the feature, then this would also be considered unfavourable, partially destroyed or even destroyed.

2.1.3 Suggested techniques

There is some difficulty in measuring the dimensions of caves. For intertidal caves, one solution for measuring height might be laser or ultrasound measuring devices (as used for example by property surveyors) (Dixon, 2000). The British Cave Research Association (BCRA) has published a handbook on cave survey methods (Ellis, 1988).

2.2 Number of caves in site

The number of caves is unlikely to change significantly over time unless as a result of some human activity, but the number nevertheless needs to be measured periodically.

2.2.1 Background to the attribute

The number of caves (either increase or decrease) is unlikely to change significantly over time unless as a result of some human activity but where a reduction in the number of caves is deemed to be attributable to anthropogenic activity (e.g. their removal or the smothering of a cave structure by material generated other than by natural processes) then the attribute would be judged as unfavourable.

Where caves are irrevocably lost due to natural processes such as cliff erosion resulting in a rock fall, the attribute should be considered partially destroyed, or even destroyed.

2.2.2 Setting a target

For some sites, it is difficult to identify an absolute number of caves. It would be important to review anthropogenic activity to see whether this might cause change.

Where the location of caves is clearly established, the number of caves should be noted and their locations marked on a map. The target should ideally be set as no loss of the number of caves during the monitoring cycle.

Issues to be considered may be:

- Ability to locate the caves accurately out in the field. There should be good provision of annotated site drawings or photographs, good dGPS points and detailed local maps. The assistance of staff with good local knowledge may also prove to be useful.

- Careful consideration must be given to the practicalities of counting caves that are known to be difficult to re-locate or gain access to for assessment.

2.3 Biotope composition of a cave

See relevant section of littoral and inshore sublittoral rock guidance.

While the generic guidance applies, there are specific cave biotopes and specific spatial arrangements resulting from light levels and scour within the cave. When formulating targets for these, you should take into account that there are cave biotopes which are not found on littoral and inshore sublittoral rock.

For the purposes of monitoring, cave biotopes can be broadly divided into those characterised by long-lived species and those characterised by ephemeral and scour-tolerant species. Long-lived species such as cup corals and large sponges may be targeted as indicators that a cave system has remained undisturbed. Individuals or individual colonies of such species might represent suitable targets for revisiting at some sites, as part of a regime of monitoring work. Recruitment of juvenile stages of such species could also be considered, although natural mortality of juvenile stages is expected to be higher than for the adults of the same species. Such long-lived species and the communities they comprise should be relatively easy to recognise and locate on each monitoring event, providing the cave systems are adequately mapped.

Natural loss and re-recruitment of ephemeral species should be expected, and it is likely that one species will be superseded by another in the time period between one monitoring event and the next. A broad-scale approach is probably necessary for monitoring the presence of ephemeral biotopes. A suitable protocol could include an assessment of whether a biotope (or one of several similar biotopes) is present in one or more of a suite of caves, rather than looking for the same biotope in the same cave each time. This broad-scale approach might have to be adopted for a range of biotopes and/or species, as accessing the same cave for each monitoring event cannot always be relied upon. Weather, poor water clarity and swell conditions can prevent surveyors entering caves for many months. A stratified random approach to selecting caves for monitoring might also help minimise possible surveyor damage to the communities within the caves (e.g. repeated visits resulting in damage from divers' exhaled air bubbles and abrasion from divers touching the cave walls).

Where the field assessment judges the biotope composition 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 temporarily 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.

Freshwater seepage into intertidal caves results in localised changes in biotope composition. Green algal films, opportunistic low salinity-tolerant macroalgae and terrestrial mosses will grow in place of fully marine communities where sufficient light reaches into the cave. Anthropogenic influences on the rate and/or quality of freshwater seepage (e.g. a new field drain channelling large amounts of water rich in nutrients into the substrata above a cave) would result in increased development of such communities and loss of marine communities.

Freshwater seepage into subtidal caves also occurs (and can be seen underwater as a shimmering effect as freshwater and seawater of different densities mix). Anecdotal evidence suggests that localised reduction in species richness occurs around the source of the seepage.

2.4 Presence of representative/notable biotopes
See relevant section of littoral and inshore sublittoral rock guidance.

2.5 Species composition of representative or notable biotopes
See relevant section of littoral and inshore sublittoral rock guidance.

2.6 Presence and/or abundance of specified species
See relevant section of littoral and inshore sublittoral rock guidance.

3 Recommended visiting period and frequency of visits

The following issues should be considered when assessing the status of caves:

3.1 Identifying change in cave biotopes
There is currently limited knowledge on the biology of cave communities. The composition and spatial extent of cave communities varies considerably, depending on the physical structure and extent of the cave system, its degree of submergence, exposure to scour and surge, and the nature of its geology. Attributes for condition assessment that measure spatial change in cave biotopes should only be used where the likely reasons for change are sufficiently well understood.

Many cave biotopes are difficult to identify and their use in condition assessment may be problematic since incorrect identification may give rise to a flawed assessment. Two issues in particular should be considered when identifying cave biotopes: non-familiarity with cave-dwelling taxa, and the scale of biological changes over small distances caused by physical conditions. Clearly, the former should be addressed when selecting and training field staff. The scale issue could be addressed by directly mapping those species responsible for the observed patterns and hence not assign biotopes. Photographs or video recordings of the defining features and species would create an important permanent record to support future monitoring interpretations.

Rapid natural change can be expected in cave biotopes characterised by ephemeral and rapid growing species that recruit seasonally. Scour from surge-mobilised material (anything from fine sand to large boulders) will periodically scour cave walls almost clean of all encrusting macrofauna/flora. This is most likely a seasonal effect and therefore some cave biotopes may look very different in late winter compared to late summer. Species such as *Spirorbis* spp., various encrusting bryozoans, *Alcyonidium diaphanum*, rapid growing encrusting sponges such as *Halichondria panicea*, anemones such as *Actinia equina* and various foliose and filamentous algae are therefore likely to fluctuate greatly in presence and abundance from year to year. Such species characterise the parts of caves subject to moderate amounts of scour, such as the walls a metre or so above the floor (in boulder or sand floored caves) and at the backs of caves where wave action is concentrated. *Sabellaria alveolata* occurs occasionally in such caves where sand is regularly suspended in the water column.

Cave habitats not subject to strong scour action may, however, develop long-lived and well-established communities characterised by large sponges (e.g. *Thymosia guernei*, *Stelletta grubii* and *Stryphnus ponderosus*) and cup corals. They may also support dense turfs of faster-growing erect bryozoans, hydroids, ascidians and other encrusting sponges. Although the latter faunal turfs probably die back and regenerate each year, cup corals, such as *Caryophyllia smithii* and the rarer *Balanophyllia regia* and *Hoplangia durotrix*, are almost certainly slow-growing and only found in habitats where physical disturbance is minimal. Un-scoured cave passages and tunnels, where water can move freely though a system, are particularly rich in sponges, and will also support dense growths of hydroids *Tubularia indivisa*, often mixed with the ascidians *Dendrodoa grossularia*, *Polycarpa scuba*, and sponges *Pachymatisma johnstonia*, *Clathrina coriacea* and *Myxilla incrustans*. These dense turfs probably vary in density and abundance seasonally if grazed by urchins and nudibranchs but are likely to regrow in the same area of a cave each year. Fluctuation in density of such species should be expected and this itself might change the appearance of some communities quite considerably (e.g. when *Tubularia indivisa* polyps are grazed).

3.2 Factors influencing cave survey

3.2.1 Physical conditions

Physical conditions such as inclination, wave surge, scour and shade, change rapidly from cave entrance to the inner parts of a cave and this often leads to a marked zonation in the communities present. Sites in which these zonation patterns are well developed have been favoured in selection.

3.2.2 Seasonal effects

Some of the more obvious visual changes occur in algal assemblages (at the entrance), and following settlements of juvenile animals such as ascidians, mussels and barnacles. Boulders present at the entrance are often seasonally stable, allowing ephemeral algal communities to develop. 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.

3.2.3 Time of assessment

Recommended timing for survey (months – weeks)

April				May				June				July				August				September				October			
X	X																									X	X

Optimum	
Possible	
Not advised	X

3.2.4 Meteorological changes

Where a cave is adjacent to sediment habitats, water movement will mobilise fine sediment into the water column, thereby reducing underwater visibility. Conversely, calm conditions will cause suspended sediment to deposit out of the water column, underwater visibility will improve and therefore assist sampling efficiency and reliability. Sublittoral caves require calm conditions to reduce surge in the cave. Ambient light levels within a cave will have a significant influence on the sampling exercise. If possible, given the many other constraints, sampling should be timed to maximise light levels, for instance, in bright sunny conditions at midday.

Storm events can move the position of boulders at the entrance to and within caves. In some cases this can significantly change the topography of the cave; influencing water flow, pool formation, scouring and subsequently the distribution of floral and faunal assemblages. Collapse of the roof can also follow these events, leading to the same impacts.

4 Additional information

4.1 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. 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, in order 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 and health and safety considerations. It may be necessary to use a boat to gain access to some caves and therefore it will be necessary to consider the availability of harbours and/or launching facilities or the use of specialist contractors. The relative ease of gaining access to a cave itself will depend on its physical size and structure. There are considerable health and safety issues to be taken into account prior to entry. Cave exploration may require staff with appropriate training and/or specialist equipment such as ladders, lighting helmets, guide ropes on reels. For caves in the intertidal zone, careful consideration must be given to the tidal cycle, to ensure that staff can complete the monitoring exercise and exit before the tide rises.

For intertidal caves, there are fewer problems in re-locating the entrance (except if very small), although it should be noted that dGPS may not provide an accurate fix near high cliffs. Accurate drawings of local landscape features provide an invaluable aid to location. For subtidal caves, provision of GPS and location guidance is insufficient. Location may be difficult, particularly in poor visibility and/or where the entrance is small**.** The installation of permanent markers may require prior consent or permission and there will be an ongoing requirement for their maintenance. Location of sampling stations and mapping 'nodes' requires carefully consideration. Fixing pitons or bolts into the rock may damage the rock, particularly soft friable rock, and create a hazard to other visitors to the cave. Paint or fluorescent markers would avoid physical damage to the rock but may attract unwanted attention from the public and reduce the scenic value of the site. The final choice of station marking will depend on the local situation but the risk of failing to find the cave or station in future monitoring studies should always be considered.

4.2 Health and safety

All fieldwork must follow approved codes of practice to ensure the health and safety of all staff. In terms of health and safety restrictions, most underground caves cannot be assessed by staff. Field staff must be briefed on the risks associated with cave survey prior to undertaking any monitoring studies.

Subtidal sampling in caves will involve SCUBA diving techniques. All diving operations are subject to the procedures described in the Diving at Work Regulations 1997[5] (see: **http://www.hse.gov.uk/lau/lacs/47-11.htm**) and must follow the Scientific and Archaeological Approved Code of Practice[6] (see **http://www.hse.gov.uk/diving/osd/part.htm#Scientific**). Divers may require specific training in cave-diving procedures to ensure their safety when surveying caves. Risks specific to working on caves are detailed in the Marine Monitoring Handbook (Davies *et al.* 2001), the NMMP's Green Book[7] and references therein.

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

[6] 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.

[7] 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**.

5 Generic attributes table

The following table lists the generic attributes that should be used to define the condition of sea cave features.

For details of assessment techniques see Section 2, littoral rock and inshore sublittoral rock feature guidance and Davies *et al*., 2001.

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

Interest feature: Sea caves

Includes the Habitats Directive Annex I habitat types: Submerged or partly submerged sea caves

Reporting category: Littoral rock, Inshore sublittoral rock

NOTE: Many cave attributes are similar to those for littoral rock and inshore sublittoral rock. This guidance should be read in conjunction with the prepared guidance on littoral rock and inshore sublittoral rock for information on the background to these selected attributes.

NOTE: All the attributes are currently deemed discretionary until further field survey provides sufficient data to formulate advice on those attributes which apply to all sites. An attribute should only be selected where it reflects the conservation interest of the individual feature on a 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 of cave(s)	No change in dimensions of a cave, allowing for natural change that are part of a wider coastal geomorphological management regime.	Extent or the dimensions of a cave should be assessed periodically and compared against a baseline map and photographs/ video or through the review of any known activities that may have caused an alteration in extent, for example rock dumping. For details of assessment techniques see Section 2, littoral rock and	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 changes in extent/dimensions are clearly

Attribute	Target	Method of assessment	Comments
		inshore sublittoral rock feature guidance and Davies *et al*., 2001.	attributable to cyclical natural processes such as erosion causing rock falls, then 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 extreme natural events (such as severe storm damage leading to a cave collapsing) cause a substantial loss of extent of the feature, then this would be considered unfavourable. Changes in extent would be considered unfavourable if attributable to activities that interrupt natural coastal processes such as coastal protection schemes or coastal development.
Number of caves in site	No reduction in the number of caves within a site allowing for natural change.	Assess the number and location of caves against the baseline condition. For details of assessment techniques see Section 2, littoral rock and inshore sublittoral rock feature guidance and Davies *et al*., 2001.	Where caves are irrevocably lost due to natural processes such as cliff erosion resulting in a rock fall, the attribute should be considered partially destroyed, or even destroyed.
Biotope composition of a cave	Maintain the variety of biotopes identified for the cave, allowing for natural succession or known cyclical change.	Repeated assessment of overall biotope composition or a subset of specified biotopes identified for the cave. For details of assessment techniques see Section 2, littoral rock and inshore sublittoral rock feature guidance and Davies *et al*., 2001.	Biotope composition of a cave is tightly linked to the prevailing physical and environmental conditions of the cave. It will vary between caves and therefore no single generic target can be specified for the entire feature where this includes multiple caves. Where changes in biotope composition are known to be attributable to natural processes

Attribute	Target	Method of assessment	Comments
			(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. 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 temporarily 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.
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, littoral rock and inshore sublittoral rock feature guidance and Davies *et al*., 2001.	Biotopes selected should reflect the specific biological characteristics or key conservation interest 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	Assessment of biotope quality through evaluating species composition where the biotope is representative of the site, or contains	Where a change in species composition is clearly attributable to natural succession, known cyclical change or mass recruitment or dieback of characterising species, then the target value

Attribute	Target	Method of assessment	Comments
	natural succession/ known cyclical change.	a number of species of conservation importance. For details of assessment techniques see Section 2, littoral rock and inshore sublittoral rock feature guidance and Davies *et al*., 2001. Assessing this attribute will require specialist taxonomic expertise.	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 species	Maintain presence and/or abundance of the specified desirable species. Absence of the specified undesirable species (such as an invasive non-native species)	Assessment of the presence/absence or abundance of a specified species identified for the feature. For details of assessment techniques see Section 2, littoral rock and inshore sublittoral rock feature guidance 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 species is 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 this should be considered as unfavourable.

6 References

Bunker, F. & Holt, R. 2003. *Survey of Sea Caves in Welsh Special Areas of Conservation 2000-2002*. A report to CCW from Marine Seen. Currently in draft form.

Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull, C. & Vincent, M. (eds.) 2001. *Marine Monitoring Handbook*. Joint Nature Conservation Committee, Peterborough, UK. ISBN 1 86107 5243. The most up-to-date version of this text may be downloaded from the JNCC web site: **http://www.jncc.gov.uk/marine**

Dixon, I. 2000. *Establishing a monitoring programme on caves in the Berwickshire and North Northumberland cSAC.* Report by ERT to English Nature.

Ellis, B. 1988. *An introduction to cave surveying. A handbook of techniques for the preparation and interpretation of conventional cave surveys.* BCRA Cave studies series no.2. Or Day, A. J. 2002. Cave Surveying. BCRA Cave studies series no.11.

Howson, C.M.(2000). Flamborough head cSAC sea cave survey. English Nature Research Report no. 379.

Wyn, G. & Kay, L. 2000. Introduction to the Estuary monitoring trial sections. In: Sanderson, W. G., Holt, R. H. F., Kay, l., Wyn, G. & Mcmath, A.J. (eds.). 2001. *The establishment of a programme of surveillance and monitoring for judging the condition of the features of Pen Llyn a'r Sarnau cSAC. Progress to March 2001.* Contract Science Report no. 380. to Countryside Council for Wales.