



Marine Monitoring Handbook

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Introduction

The European Community has adopted two Directives which aim to conserve nature within the territory of the European Union. Firstly, Council Directive 92/43 EEC of 21 May 1992 on the *Conservation of natural habitats and of wild fauna and flora* (the Habitats Directive) requires that Member States designate Special Areas of Conservation for specified habitats and the habitats of specified species of wild plants and animals. Secondly, Council Directive 79/409 EEC of 2 April 1979 on the *Conservation of wild birds* (the Birds Directive) requires Member States to designate Special Protection Areas for the conservation of specified wild birds, and for regularly occurring migratory birds. Both these Directives apply to the marine environment of the European Union as well as to the terrestrial and freshwater environments.

The requirement to designate Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) is implemented in Great Britain by the *Conservation (Natural Habitats etc.) Regulations 1994* and in Northern Ireland by the *Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995*. These Regulations make provision for the implementation of the Directives in the marine environment, including the preparation of Schemes of Management (hereafter called *Management Schemes*) for marine SACs and SPAs. The Regulations refer to marine SACs and SPAs collectively as European marine sites. The Regulations, and the Management Schemes prepared under them, are intended to maintain the conservation value of the European marine sites for the particular habitats or species for which they were designated.

Monitoring of European marine sites is necessary to determine the condition of the sites, to indicate whether management measures undertaken under the Management Schemes are proving effective, and to identify, where possible, any detrimental effects. Where such effects are recorded, they are likely to act as a trigger for further investigative studies to determine what, if any, remedial action can be taken.

The UK Marine SACs project has investigated methods and strategies to monitor the condition of those marine habitats and species listed on Annexes I and II of the Habitats Directive which occur in the 12 trial sites covered by the project. As part of this investigation, a number of these methods were tested on site to examine their cost-effectiveness and practicality. The trials concentrated either on applying developing technologies such as airborne remote sensing to SAC monitoring, or on new methods for deploying existing techniques. It did not test techniques that are well established for site monitoring.

The *Marine Monitoring Handbook* explains the need for monitoring on marine SACs, sets out the approach to such monitoring which is being adopted by the United Kingdom, provides assistance with the design of monitoring programmes, gives specific guidance on monitoring methods appropriate to a range of marine SAC habitats and species, and provides information on the practical application of the monitoring methods. Figure i on page 11 provides an overview of the monitoring process and shows where in the *Marine Monitoring Handbook* advice may be sought.

The Handbook is intended, primarily, for those responsible for designing and implementing monitoring programmes for marine SACs (Box 1-1). While the guidance provided is relevant to the habitat attributes of marine SPAs, methods for assessing bird populations have already been published^{a,b} and are not included in this Handbook.

Box 1-1 Aim

The Marine Monitoring Handbook provides advice on monitoring marine Special Areas of Conservation to assess their condition in accordance with the requirements of the Habitats Directive and UK common standards for monitoring.^c

Legislative background for monitoring on SACs

The purpose of designating and conserving Special Areas of Conservation is to maintain or restore the habitats listed on Annex I and the species listed on Annex II of the Directive to *Favourable Conservation Status*. Favourable Conservation Status is defined in Article 1 of the Directive. In summary, for Annex I habitats, it means that conditions have been established which will ensure that the extent and range of the habitat, and the populations of the constituent species of that habitat, will be maintained or increased over time. For Annex II species, it means that conditions have been established which will ensure that the viability, population size and range of that species will be maintained in the long term.

The term Favourable Conservation Status relates to the individual habitats and species over their natural range within the European Union. However, because the selection of the European network of SACs is seen as fundamental to achieving Favourable Conservation Status, the European Commission considers that the concept should also be applied at the site level.^d A key purpose of SAC monitoring, therefore, will be to determine whether Favourable Conservation Status of the habitats and species is being achieved at the level of individual SACs. The UK conservation agencies use the term *favourable condition* to represent the concept of Favourable Conservation Status for the interest features of an individual SAC.

In addition to this general point, the Habitats Directive also includes a number of specific provisions which require the undertaking of monitoring on SACs. The most important of these are:

- **Article 11**

Member States shall undertake surveillance of the conservation status of the natural habitats and species referred to in Article 2 with particular regard to priority natural habitat types and priority species.

This Article requires Member States to undertake surveillance of the conservation status of the natural habitats and species listed on the Annexes of the Directive, with particular regard to priority habitats and species. This surveillance requirement relates to the conservation status of the habitats and species throughout the territory of the Member State. It is reasonable to infer that the importance of surveillance of a given habitat or species on an individual marine SAC can be viewed as being proportionate to the importance of the site to the status of the habitat or species within the territory of the Member State as a whole.

- **Article 17(1)**

1. Every six years from the date of expiry of the period laid down in Article 23, Member States shall draw up a report on the implementation of the measures taken under this Directive. This report shall include in particular information concerning the conservation measures referred to in Article 6 (1) as well as evaluation of the impact of those measures on the conservation status of the natural habitat types of Annex I and the species in Annex II and the main results of the surveillance referred to in Article 11. The report, in accordance with the format established by the committee, shall be forwarded to the Commission and made accessible to the public.

This Article requires Member States to prepare a report by June 2000,¹ and every six years afterwards, on the measures taken to achieve the conservation of SACs, and also to undertake an evaluation of the effect of these measures on the conservation status of Annex I habitats and Annex II species. Monitoring is needed in order to carry out this evaluation. The main results of the surveillance carried out under Article 11 are also to be included in the Report.

In addition to the requirements of the Habitats Directive, Article 8 of the EC Water Framework Directive will require Member States to ensure the establishment of programmes for monitoring the status of protected areas (including SACs). The purpose of such monitoring is to gauge whether the water-related ecological requirements (e.g. the water quality) of the SACs are being met.

¹ The report due in June 2000 has been deferred for one year to June 2001.

Summary

The EC legislation requires the condition of the habitats and species for which an SAC has been designated to be monitored, in a manner which enables the condition of the feature to be estimated, and whether management measures undertaken on the site are proving effective in achieving their favourable condition.

The UK approach to SAC monitoring

In the United Kingdom, an approach to the monitoring of wildlife sites which have been designated under both national and EC legislation has been developed which meets the requirements for monitoring of SACs. In this approach, a distinction is made between *surveillance* and *monitoring*.

Box 1-2 Definitions

Surveillance is a continued programme of biological surveys systematically undertaken to provide a series of observations in time.

Monitoring is surveillance undertaken to ensure that formulated standards are being maintained.

Because the purpose of SACs is to contribute to achieving Favourable Conservation Status for the habitats and species for which they were selected, work undertaken to assess whether SACs are making the contribution expected of them falls into the category of monitoring as defined in Box 1-2.

The Annex I habitats and Annex II species for which SACs have been selected are referred to collectively in the United Kingdom as *interest features*. Table 1-1 lists those marine interest features which occur in the United Kingdom and are covered by this handbook.

Table 1-1 Marine interest features occurring in the UK for which advice on monitoring the feature's condition is provided in Sections 3 and 4 of this handbook.

<i>Annex I habitats</i>	<i>Annex II species</i>
Sandbanks which are slightly covered by seawater at all times	<i>Phoca vitulina</i> (Common seal)
Mudflats and sandflats not covered by seawater at low tide	<i>Halichoerus grypus</i> (Grey seal)
Reefs	<i>Tursiops truncatus</i> (Bottlenose dolphin)
Submerged or partially submerged sea caves	
Lagoons	
Estuaries	
Large shallow inlets and bays	

The approach to monitoring SACs in the UK is based on the requirement to assess whether the interest feature for which the site has been selected is in *favourable condition*. Favourable condition is the state which needs to be achieved by an interest feature and corresponds to Favourable Conservation Status at the level of the individual SAC (Figure 1-1).

Favourable condition, therefore, is the 'formulated standard' referred to in the definition of monitoring given in Box 1-2, and has to be defined for each interest feature on each SAC. To accomplish this, and to achieve as far as possible a full alignment with management measures and controls established under Management Schemes, the UK has formulated standards based on the *conservation objectives* developed for each interest feature on each SAC.

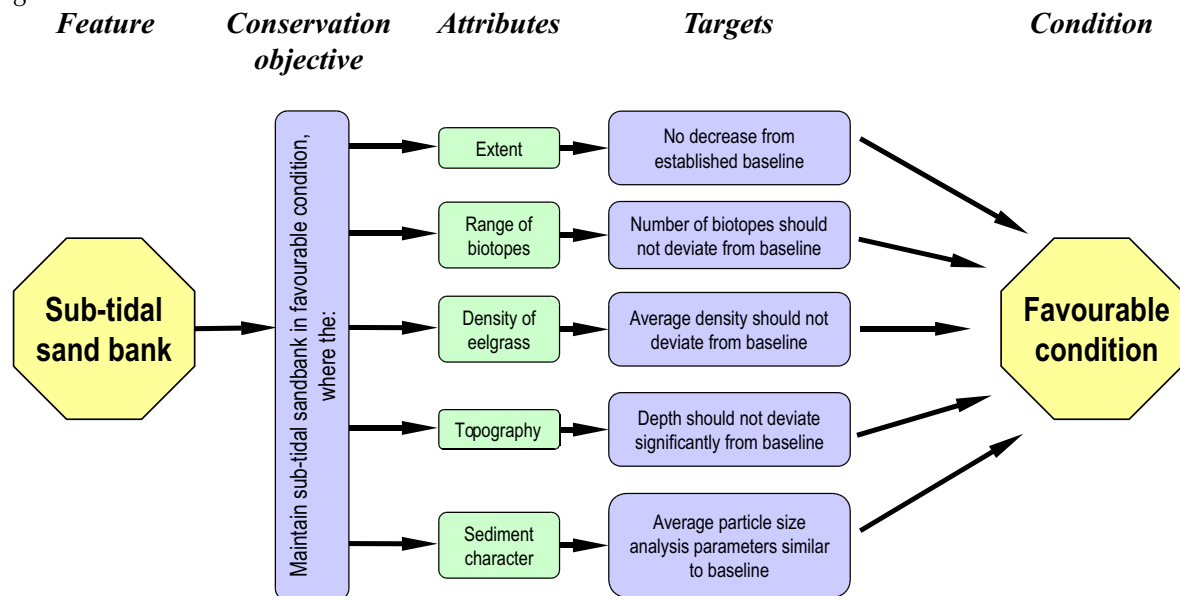


Figure 1-1 Diagrammatic representation of the UK's approach to setting a conservation objective for a marine SAC feature.

Conservation objectives

The Habitats Directive implies that conservation objectives will be developed for SACs, and explicitly refers to these in the context of appropriate assessment of plans and projects under Article 6. The UK's national implementing Regulations have developed the concept further and require the country nature conservation agencies to advise all relevant authorities of the conservation objectives for each marine SAC. A conservation objective is a statement of the nature conservation aspirations for the interest features on an SAC, expressed in terms of broad targets that define favourable condition."

The process of defining favourable condition of an interest feature can be thought of as consisting of two elements:

- 1) Identifying the most important characteristics of the interest feature that define its condition. Depending on the feature concerned, this will usually include some combination of the:
 - quantity of the feature, for example the extent of habitat, or habitat of the species, or abundance of the species, and related characteristics such as range of distribution, and whether its spatial occurrence is patchy or continuous;
 - quality of the feature, for example for a habitat, the presence or abundance of component species, or the quality of inorganic components of the habitat such as substrata; for a species population, measures of quality could include characteristics such as age or size structure, productivity rate, and even aspects of the 'health' of individuals;
 - processes supporting the feature, such as physical environmental factors like water quality, water movement (levels and flows) or sediment processes, where they are of overriding importance to the condition of a habitat or species; for example, the salinity patterns observed in a lagoon.
- 2) Identifying the state or value, or range of values, for the selected characteristics which the feature needs to have if it is to be considered as being in favourable condition. These values need to recognise, so far as possible, the fluctuations which are part of the feature's natural dynamics.

As a guide, and in the absence of information on which to base a different conclusion, the 'value' of the characteristics at the time when the feature was selected is assumed to be representative of favourable condition. The United Kingdom refers to the characteristics described above as *attributes*.

Sub-features

The marine Annex I habitats are very broadly defined habitats that are often represented by large and complex sites. To effectively describe, monitor and manage such complex features, it has been necessary to divide some of them into smaller units called *sub-features*. Sub-features are distinctive biologi-

cal communities (e.g. eelgrass beds, maerl beds, horse-mussel reefs), or particular structural or geographical elements of the feature (see Figure 1-2). Sub-features have often proved helpful, both in the development of conservation objectives, and of monitoring programmes, to separate the feature into a number of constituent sub-features, and then to identify attributes and targets for the sub-features. The use of sub-features has been found to be particularly helpful for those marine Annex I features that represent whole physiographic units,² and permits a level of flexibility in the application of the UK's Common Standards Monitoring which has been found necessary when applying the standards at the site level.

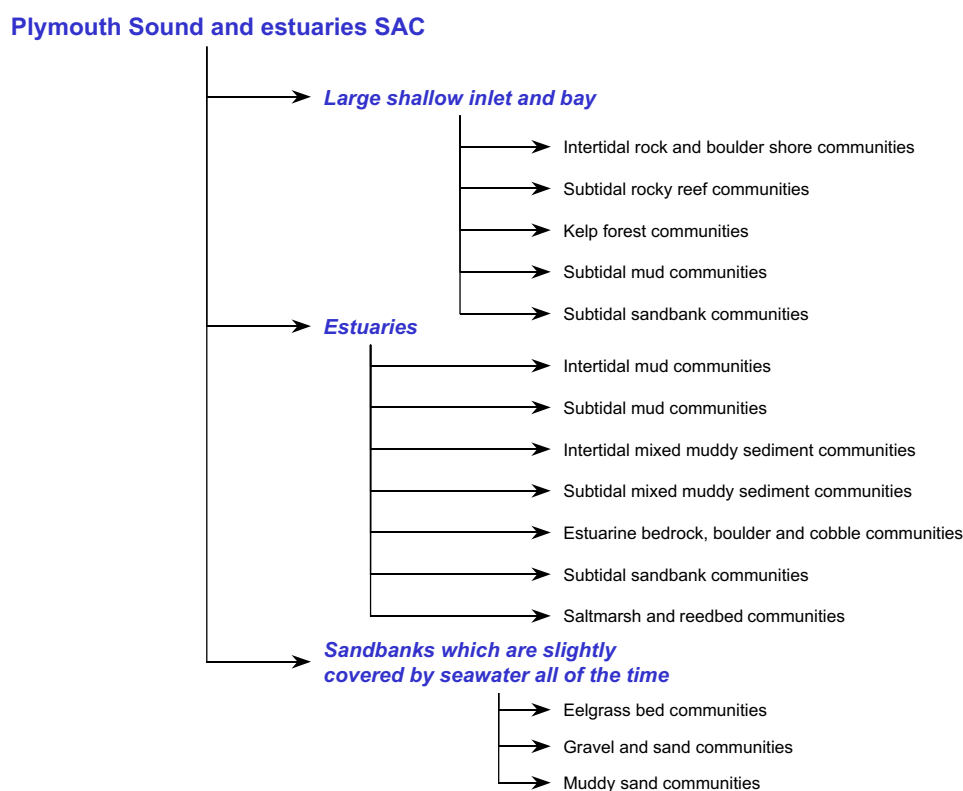


Figure 1-2 An example of how complex Annex I features (bold italic) are divided into sub-features (normal text) for a large SAC.

Attributes

As explained above, conservation objectives for each feature on each SAC are developed by identifying the attributes which describe and support the (sub) feature, and by the setting of values, or a range of values, for each of these which reflect the best judgement as to what is required to define the feature as being in good condition. It is quite impractical to set conservation objectives for every conceivable attribute for a particular feature and, even if this were done, the cost of monitoring all of these to assess the condition of the feature would be prohibitive.

For this reason, conservation objectives are developed for those attributes considered to be essential. The nature conservation agencies in the United Kingdom are currently increasing their experience in developing conservation objectives for marine interest features, and the understanding of which attributes are the most important may need to change as our understanding improves. Examples of attributes are given in Box 1-3. The United Kingdom refers to the attribute values which help to define favourable condition as *targets*.

In practice, in the marine environment it has proved useful to consider attributes in meaningful groups under a range of sub-features.

² Estuaries, large shallow inlets and bays, caves, and lagoons.

Box 1-3 Examples of Attributes

Extent of the feature
Diversity of constituent biotopes
Extent of important constituent biotopes
Distribution of important constituent biotopes
Species composition of important biotopes
Important topographic features such as bathymetry
Water temperature
Turbidity
Nutrient status
Sediment (or other substratum) character

Summary

A summary of the approach used to define favourable condition for an interest feature on an individual SAC is, therefore, as follows:

- 1) Identify and define any sub-features that are important components of the feature.
- 2) Identify the attributes for the interest feature, and any sub-features, which are considered, on best judgement, to be essential to assess its condition.
- 3) Set targets for those attributes.
- 4) Formulate conservation objectives for the feature based on the aggregation of all the selected attributes and their targets.

These conservation objectives then define favourable condition for the feature.

The role of monitoring in judging favourable condition

Monitoring the selected attributes provides the information to compare their actual values at the time of recording with the target values, to enable an assessment of whether or not the feature (or sub-feature) is in favourable condition.

The United Kingdom uses this approach in the monitoring of all sites designated under national and EC nature conservation Directives, and refers to the approach as *Common Standards Monitoring*. The approach has a number of advantages:

- At a local level, it provides a framework for those responsible for developing and implementing monitoring programmes to do so with the confidence that this framework is supported nationally and is being implemented throughout the country.
- It enables judgements to be made about the condition of features which are consistent between one person and another, and between one site and another.
- Collecting, managing and exchanging monitoring information using accepted standards can be done at a much lower cost than would otherwise be possible, and use of the standards also facilitates the comparison of results over time and between different localities.
- It enables the UK to report on the condition of each feature at the national level to the EC.

Frequency of monitoring

The Habitats Directive requires Member States to report on the status of the habitats and species of Community interest every six years. In conformity with this, the UK has adopted the practice of monitoring all designated sites, including SACs, on a six-year cycle. Within this overall six-year monitoring cycle, each interest feature within a site must be monitored, preferably within the same year, but cer-

tainly within a three-year period.

Some features within sites will be monitored more frequently than this. Marine SAC features particularly will need more frequent monitoring in forthcoming years to adequately establish their inherent variation and better judge the appropriateness of target values already set, or define target values for those attributes where there are few existing data.

Judging the condition of sites

The condition of designated features is judged to fall into one of seven categories (see Box 1-4). The first two of these are termed *favourable* and features which are assessed as falling into these categories meet the requirements of favourable condition. The remainder do not.

The Common Standards Monitoring model for designated nature conservation sites adopted by the United Kingdom also includes the monitoring of management measures and activities, but these are not included within the Handbook. The Common Standards Monitoring procedures are summarised in Box 1-4.

Box 1-4 Some key aspects of the framework of Common Standards Monitoring**FEATURES TO BE MONITORED**

The features to be monitored and reported will be, in the case of Natura 2000, the features for which the site is designated.

For monitoring purposes, the special interest of the site may not always be dealt with as a single entity since many sites have a complex mix of Annex I habitats or Annex II species, which provide the justification for the designation of the site. However, the individual features of interest should be identified, monitored and reported on separately. These interest features are described in the notification documents and are the reasons for designating the site. Until SACs are formally designated the interest features are those for which the site was selected.

CONSERVATION OBJECTIVES

Conservation objectives will be prepared for interest features on all sites. Each objective will define what constitutes favourable condition of each feature by describing broad targets which should be met if the feature is to be judged favourable.

Each interest feature of a site will have one or more attributes that can be used to help define Favourable Condition. For species these may include population size, structure, habitat requirements and distribution. Attributes of habitats may include area covered, key species, composition and structure and supporting processes.

Broad targets will be identified for those attributes that most economically define Favourable Condition of the interest feature. Because all features are subject to some degree of change, the targets may express how much change we would accept while still considering the feature to be in Favourable Condition. If a feature changes to the extent that it falls outside the thresholds expressed then this acts as a trigger for remedial action or further investigation.

MONITORING CYCLE

The overall cycle will ensure that the interest features will be monitored at least once within six years. However, for any particular site each interest feature should be monitored within a three-year period.

Within the overall monitoring cycle, it will be useful to form a view of the overall condition of the features within a proportion of the statutory sites on a more frequent basis. Each interest feature within a site should therefore be monitored, preferably within the same year, but certainly within a three-year period.

JUDGING THE CONDITION OF SITES

The condition of site features will be assigned against the following categories:

Favourable – maintained. An interest feature should be recorded as maintained when its conservation objectives were being met at the previous assessment, and are still being met.

Favourable – recovered. An interest feature can be recorded as having recovered if it has regained Favourable Condition, having been recorded as unfavourable on the previous assessment.

Unfavourable – recovering. An interest feature can be recorded as recovering after damage if it has begun to show, or is continuing to show, a trend towards Favourable Condition.

Unfavourable – no change. An interest feature may be retained in a more-or-less steady state by repeated or continuing damage. It is unfavourable but neither declining nor recovering. In rare cases, an interest feature might not be able to regain its original condition following a damaging activity, but a new stable state might be achieved.

Unfavourable – declining. Decline is another possible consequence of a damaging activity. In this case, recovery is possible and may occur either spontaneously or if suitable management input is made.

Partially destroyed. It is possible to destroy sections or areas of certain features or to destroy parts of sites with no hope of reinstatement because part of the feature itself, or the habitat or processes essential to support it, has been removed or irretrievably altered.

Destroyed. The recording of a feature as destroyed will indicate the entire interest feature has been affected to such an extent that there is no hope of recovery, perhaps because its supporting habitat or processes have been removed or irretrievably altered.

These categories will be used to assess and report on the condition of features of interest.

Judgements on the overall condition of a feature will be influenced by a variety of factors and in some cases a feature may be assessed as being in Favourable Condition when only some of the targets set for it have been met.

REPORTING ARRANGEMENTS

A full report will be produced once every six years. The monitoring framework will generate information on the condition of features across the statutory site network as a whole, or on the status of features within individual sites, and will be used to fulfil reporting requirements under the Habitats Directive (and other International Conventions).

Context of SAC monitoring within the Scheme of Management

The context of monitoring within the Management Scheme prepared for an individual SAC is illustrated in Figure 1-3. The monitoring of the condition of SACs is co-ordinated by the statutory nature conservation agencies, though other authorities may actually carry out monitoring activities where this is appropriate.

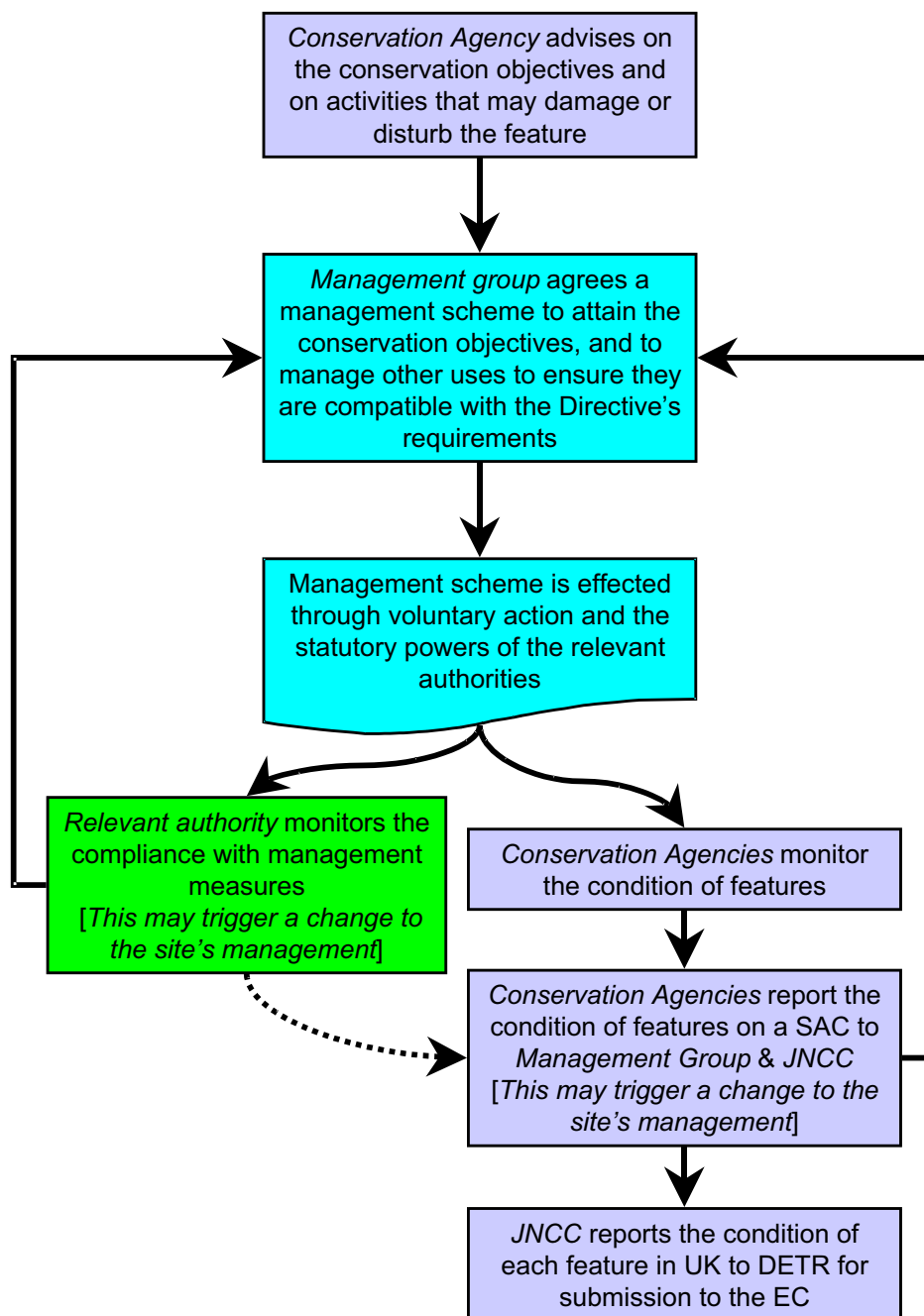


Figure 1-3 Outline of the process of establishing a management scheme incorporating a monitoring programme on an SAC, showing the organisations responsible for each stage (after Anon 1998³). *Conservation Agency*: Countryside Council for Wales, English Nature, Environment and Heritage Service (Northern Ireland), Scottish Natural Heritage. *Relevant Authority*: the specific competent authority³ which has powers or functions which have, or could have, an impact on the marine environment within or adjacent to a SAC. *Management Group* comprises the relevant authorities and conservation agency members. DETR: Department for the Environment, Transport and the Regions.

³ A competent authority is any minister, government department, public or statutory undertaker, public body or person holding public office that exercises statutory powers.

Using data from existing monitoring programmes

The United Kingdom has a long history of long-term investigations in the marine environment, both at a local and national scale. Universities and research institutes have generally pursued local programmes such as the benthic investigations by the University of Newcastle's Dove Marine Laboratory off the coast of NE England (Buchanan and Moore 1986).^g National monitoring programmes have been undertaken by statutory agencies, usually as part of their regulatory functions; for example, the Ministry of Agriculture, Fisheries and Food monitor the physio-chemical parameters of seawater in relation to the disposal of contaminants (MAFF 1994).^h Existing monitoring programmes are expected to make a significant contribution to SAC monitoring, in terms of providing data at a site where sampling stations fall within the SAC boundary, and provide wider contextual information on the state of the environment. Also, these existing programmes can make an important contribution to the development of SAC monitoring strategies and the interpretation of results. When developing site-based objectives, these long-term programmes can contribute data on the variability of an attribute to help set realistic targets. During a monitoring programme, comparing the results gathered at a local level with any national trends may provide additional insights into an explanation of a local change. It is, therefore, prudent for those establishing SAC monitoring schemes to undertake a comprehensive review to identify any existing long-term programmes that may contribute to future monitoring effort. National monitoring in the marine environment is undertaken *inter alia* under the auspices of the Marine Pollution Management and Monitoring Group (MPMMG)⁴ established by the Department of the Environment, Transport and the Regions. One such scheme is the UK National Marine Monitoring Programme.

The UK National Marine Monitoring Programme

The UK National Marine Monitoring Programme⁵ (NMMP) was devised in response to the 1986 House of Lords Select Committee on Marine Science and Technology, who recommended that a common approach to monitoring should be established. This should provide all the information required to comply with the full range of national and international commitments (e.g. under the OSPAR Convention and EC Directives). Overall responsibility for the NMMP rests with the MPMMG. The NMMP is described in the *Green Book*,ⁱ which includes procedural guidelines for the collection, processing and analysis of samples.⁶

Sampling is undertaken annually by the Environment Agency and Centre for Environment, Fisheries and Aquaculture Science in England and Wales, the Scottish Environment Protection Agency and the Fisheries Research Service in Scotland, and the Department of Agriculture and Rural Development and the Environment and Heritage Service in Northern Ireland. It focuses on stable depositional sediment sites and records data on sediment chemistry, biological communities, bioaccumulation of mercury, cadmium and lead, and their ecological effects. Samples are collected at each of approximately 115 stations around the UK (Figure 1-4): there are 40 estuarine sites, 45 intermediate (coastal) sites and 30 off-shore sites. The programme has become biology-led because the prevailing biological assemblage is considered to integrate and reflect the effects of the wide range of physical and chemical conditions occurring at each site. However, a perceived weakness is the difficulty of linking cause and effect. A National Marine Biology Analytical Quality Control Scheme (NMBAQC) was established in 1992 and has undertaken various exercises and workshops involving more than 25 laboratories to establish quality assurance standards for the biological aspects of the NMMP. Similar schemes exist for chemical monitoring (NMCAQC) and ecotoxicological monitoring (NMEAQC).

4 See: <http://www.environment.detr.gov.uk/marine/mpmmg/index.htm>

5 See: <http://www.marlab.ac.uk/NMMP/NMP.htm> for a list of links and <http://www.environment-agency.gov.uk/s-enviro/viewpoints/5change-ltrs/3nmmp/5-3.html> for an explanation.

6 The Green Book is a controlled document distributed by Fisheries Research Service, Marine Laboratory, Aberdeen: contact Dr Gill Rodger (rodgergk@marlab.ac.uk). The text may be downloaded from: <http://www.marlab.ac.uk/greenbook/GREEN.htm>

These schemes provide a potential model for establishing quality assurance measures in SAC monitoring.

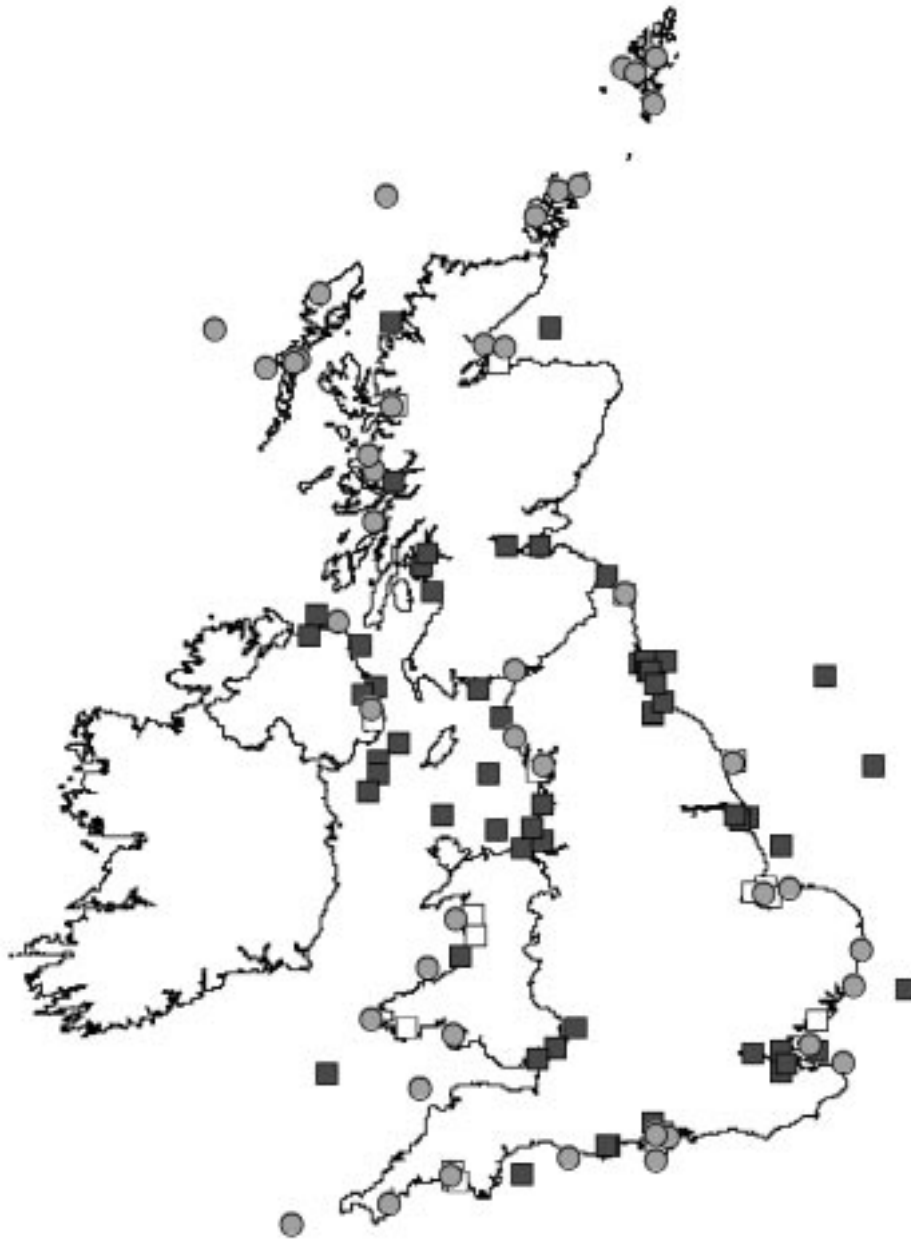


Figure 1-4 Location of the National Marine Monitoring Programme (NMMP) sample sites in the UK. Key: ● - cSAC (pre moderation⁷); □ - NMMP sites within cSACs; ■ - NMMP sites (see <http://www.environment-agency.gov.uk/s-enviro/viewpoints/5change-ltrs/3nmmp/5-3a.html>).

Biological survey in the NMMP is based on macrobenthic sampling using grab and core sampling of subtidal sediment biotopes. Being quantitative counts of individual organisms, the results lend themselves to the use of diversity indices and multivariate analysis to indicate 'health' and extent of change. Analyses of the entire data set provide an indication of any national trends in the 'health' of these biological communities. The first holistic NMMP report on this spatial survey, *National Monitoring Programme Survey of the Quality of UK Coastal Waters*,^j was published in November 1998.

⁷ The original UK list of cSACs was reviewed at the EC Atlantic Biogeographic Region meeting at Kilkee, Ireland in October 1999; the UK is currently revising its list following this meeting.

These national results will provide an important context for assessing the significance of any localised change recorded during a SAC monitoring study.

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