BERWICKSHIRE AND NORTH NORTHUMBERLAND COAST

EUROPEAN MARINE SITE

English Nature's and Scottish Natural Heritage's advice given in compliance with Regulation 33 (2) and in support of the implementation of The Conservation (Natural Habitats &c.) Regulations 1994

14th June 2000

English Nature's and Scottish Natural Heritage's advice for the Berwickshire and North Northumberland Coast European marine site given in compliance with Regulation 33(2) and in support of the implementation of the Conservation (Natural Habitats &c.) Regulations 1994

Preface

This document provides English Nature's and Scottish Natural Heritage's joint advice to other relevant authorities as to, and in support of, (a) the conservation objectives and (b) any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for the Berwickshire and North Northumberland Coast European marine site. This advice is being prepared to both comply with, and support, our obligations under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994. Sections of the document that comply directly with the requirements of Regulation 33 are identified separately (on coloured paper) from those which are included to support this advice.

The Berwickshire and North Northumberland Coast European marine site is part of a candidate Special Area of Conservation. It is Government policy that such sites should be protected as if they were already designated and, where appropriate, it is desirable to establish voluntary management schemes at an early stage, before the formal statutory obligations apply, and to act in the spirit of the Directive in the meantime (DETR & The Welsh Office, 1998). In light of this policy, we have worked with many of you to develop this advice in advance of statutory obligations applying. It should be noted however, that amendments to the Habitats Regulations are now in force which will result in the statutory obligations within the Regulations being applied to candidate SACs earlier in the process than previously.

European marine sites are defined in the Conservation (Natural Habitats &c.) Regulations 1994 as any part of a European site covered (continuously or intermittently) by tidal waters or any part of the sea in or adjacent to Great Britain up to the seaward limit of territorial waters. European sites include Special Areas of Conservation under the Habitats Directive, which support certain natural habitats and species of European importance, and Special Protection Areas under the Birds Directive which support significant numbers of internationally important wild birds. In many instances, as in the case of the Berwickshire and North Northumberland Coast European marine site, these designations may coincide and our advice is being prepared to cover both the SAC and SPA interests.

This 'Regulation 33 package' is designed to help relevant and competent authorities, who have responsibilities to implement the Habitats Directive, to:

- understand the international importance of the site, underlying physical processes and the ecological requirements of the habitats and species involved;
- develop a management scheme which will ensure that the ecological requirements of the site's interest features are met and continue to be met; and
- set the standards against which the condition of the site's interest features can be determined and undertake compliance monitoring to establish whether they are in favourable condition.

In addition, the Regulation 33 package will provide a basis to inform the scope and nature of 'appropriate assessment' required in relation to plans and projects (Regulations 48 & 50 and by English Nature and Scottish Natural Heritage under Regulation 20). English Nature and Scottish Natural Heritage will keep this advice under review and may update it every six years or sooner, depending on the changing circumstances on the European marine site. In addition we will be providing more detailed advice to competent and relevant authorities to assess the implications of any given plan or project under the Regulations, where appropriate, at the time a plan or project is being considered. If during the European Union's moderation process qualifying interest features are added to this European marine site, English Nature and Scottish Natural Heritage will add to this advice as appropriate.

English Nature / Scottish Natural Heritage – 14th June 2000

English Nature's and Scottish Natural Heritage's advice for the Berwickshire and North Northumberland Coast European marine site given in compliance with Regulation 33(2) and in support of the implementation of the Conservation (Natural Habitats &c.) Regulations 1994

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1 Introduction

This section is included to provide relevant contextual information in support of the advice required under Regulation 33.

1.1 Natura 2000

The European Union Habitats[1] and Birds[2] Directives are international agreements which set out a number of actions to be taken for nature conservation. The Habitats Directive aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements, and sets out measures to maintain or restore natural habitats and species of European Union interest at a favourable conservation status[3]. The Birds Directive protects all wild birds and their habitats within the European Union, especially migratory birds and those that are considered rare or vulnerable.

The Habitats and Birds Directives include requirements for the designation of conservation areas. In the case of the Habitats Directive these areas are Special Areas of Conservation (SACs) which support certain natural habitats or species, and in the Birds Directive, Special Protection Areas (SPAs) which support wild birds of European Union interest. These sites will form a network of conservation areas to be known as "Natura 2000". Where SACs or SPAs consist of areas covered continuously or intermittently by tidal waters or any part of the sea in or adjacent to Great Britain up to the seaward limit of territorial waters, they are referred to as European marine sites.

Further guidance on European marine sites is contained in the Department of the Environment Transport and Regions/Welsh Office document: *European marine sites in England & Wales: A guide to the Conservation (Natural Habitats &c.) Regulations 1994 and to the preparation and application of management schemes.* Guidance and advice relevant in Scotland can be found in Scottish Office Circular No. 6/1995, *Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna, and the Conservation of Wild Birds: The Conservation (Natural Habitats & c.) Regulations 1994.*

1.2 The role of English Nature and Scottish Natural Heritage

The Conservation (Natural Habitats &c.) Regulations 1994 translate the Habitats Directive into law in Great Britain. It gives English Nature and Scottish Natural Heritage a statutory responsibility to advise relevant authorities as to the conservation objectives for European marine sites in England and Scotland, and to advise these authorities as to any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the site has been designated. This information will be a key component of any of the management schemes which may be developed for these sites.

This document is the advice required under Regulation 33(2) issued by both English Nature and Scottish Natural Heritage in fulfilment and support of Regulation 33 (2) of the Conservation (Natural Habitats &c.) Regulations 1994 (the Regulation 33 package). Copies of key references quoted in this document are held at English Nature or Scottish Natural Heritage's local offices.

In addition to providing such advice, the Regulation 33(2) advice, plus supporting information will help to inform on the scope and nature of "appropriate assessment" which the Directive requires to be undertaken for plans and projects which are likely to have a significant effect on the interest features (Regulations 48 & 50 and by English Nature and Scottish Natural Heritage under Regulation 20). In the future English

[1] Council Directive 92/43/EEC on the conservation of natural habitats of wild fauna and flora.
[2] Council Directive 79/409/EEC on the conservation of wild birds.
[3] A habitat or species is defined as being at favourable conservation status when its natural range and the areas it covers within that range are stable or increasing and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future.

Nature and Scottish Natural Heritage may also provide more detailed advice to competent and relevant authorities to assess the implications of any such plans or projects.

1.3 The role of relevant authorities

The Conservation (Natural Habitats &c.) Regulations 1994 require relevant authorities to exercise their functions so as to secure compliance with the Habitats Directive. The single management scheme which the relevant authorities are drawing up under Regulation 34 for the Berwickshire and North Northumberland Coast European marine site will provide the framework through which this will be done and it should be based on the advice in this package. In this respect, relevant authorities must, within their areas of jurisdiction, have regard to both direct and indirect effects on an interest feature of the site. This may include consideration of issues outside the boundary of the European marine site.

Relevant authorities should ensure that all plans for the area integrate with the management scheme for the European marine site. Such plans may include, amongst others, shoreline management plans, local Environment Agency plans, SSSI management plans, local BAP plans, Coastal Habitat Management Plans and sustainable development strategies for estuaries. This must occur to ensure that there is only a single management scheme through which all relevant authorities exercise their duties under the Conservation (Natural Habitats &c.) Regulations 1994.

Relevant authorities also need to have regard to changing circumstances of the SAC and SPA and may therefore need to modify the management scheme and or the way in which they exercise their functions so as to maintain the favourable condition of interest features concerned in the long term. There is no requirement for relevant authorities to take any actions outside their statutory functions.

Under certain circumstances, where another relevant authority is unable to act for legal reasons, or where there is no other relevant authority, English Nature or Scottish Natural Heritage are empowered to use their byelaw-making powers for Marine Nature Reserves (MNR) for use in European marine sites.

1.4 Activity outside the control of relevant authorities

Nothing within this package will require relevant authorities to undertake any actions or ameliorate changes in the condition of interest features if it is shown that changes result wholly from natural causes[4]. This also applies if the changes, although causing deterioration or disturbance to the interest features, are the result of human or natural events outside their control. When this advice is issued, English Nature and Scottish Natural Heritage will work with relevant authorities and others to agree, within a defined time frame, a protocol for evaluating all observed changes to baselines and to develop an understanding of natural change and provide further guidance as appropriate and possible. On the Berwickshire and North Northumberland Coast European marine site a management group has already been established and should be able to alert either English Nature or Scottish Natural Heritage to such issues so that they may be assessed and any appropriate measures taken. This does not however preclude relevant authorities from taking action to prevent deterioration to the interest features, for example by introducing or promoting codes of practice through the management group.

[4] Determination of what constitutes natural change will be based on the best available information and scientific opinion at the time.

1.5 Responsibilities under other conservation designations

In addition to its candidate SAC and classified SPA status, parts of the Berwickshire and North Northumberland Coast are also designated and subject to agreements under other conservation legislation and agreements (e.g. SSSIs notified under the Wildlife and Countryside Act 1981 as amended 1985 and important wetland sites under the Ramsar convention). The obligations of relevant authorities and other organisations under such designations are not affected by the advice contained in this document.

1.6 Role of conservation objectives

Section 5 of this document sets out the conservation objectives for the Berwickshire and North Northumberland Coast European marine site as required under Regulation 33 (2)(a). They are the starting point from which management schemes and monitoring programmes are to be developed as they provide the basis for determining what is likely to cause a significant effect, and for informing on the scope of appropriate assessments of plans or projects. The conservation objectives set out what needs to be achieved and thus deliver the aims of the Directive.

1.7 Role of advice on operations

The advice on operations set out in Sections 7 and 8 provides the basis for discussion about the nature and extent of the operations taking place within or close to the site, and which may have an impact on its interest features. It is given on the basis of the working assumption that sites have been generally presumed to have been in a favourable condition at the time they were identified. This assumption will be tested during the 2000-2006 reporting period. The advice should also be used to identify the extent to which existing measures of control, management and use are, or can be made consistent with the conservation objectives and thereby focus the attention of relevant authorities and surveillance areas that may need management measures.

This operations advice, will need to be refined through further detailed discussions with the management and advisory groups in formulating and agreeing a management scheme, where required, to agreed time scales for the European marine site.

2 Identification of interest features under the Habitats and Birds Directives

This section is included to provide relevant contextual information in support of the advice required under Regulation 33(2).

2.1 Introduction

The Berwickshire and North Northumberland Coast is one of the most varied stretches of coastline in the UK. It contains a complex of marine habitat types and associated species and communities which is unusually diverse for the North Sea, in both a UK and European context. The site contributes to the important range and variation of intertidal mudflats and sandflats in the UK as the best example of east coast clean sand and seagrass beds, and of moderately exposed reefs. Intertidal and submerged sea caves also contribute significantly to the site's overall habitat diversity and international importance. The Berwickshire and North Northumberland Coast also provides important habitats for the grey seal *Halichoerus grypus* in that it supports some 3% of the British annual pup production (Brown *et al*., 1997). The site also supports internationally important populations of overwintering and summer breeding bird species.

The Berwickshire and North Northumberland Coast is a candidate Special Area of Conservation (SAC). As illustrated in Figure 1, there are four classified Special Protection Areas (SPA) within the area of the SAC. These are St Abbs Head to Fast Castle, Lindisfarne, the Farne Islands, and the Northumbria Coast. The marine components of these sites each qualify as European marine sites, but for simplicity, and for the purposes of this advice, both the SAC and SPA marine components are treated as a single European marine site. Accordingly, the advice contained within this document covers both the SAC habitat interests and the Lindisfarne SPA bird interests of the European marine site.

The features for which the SAC and SPA have been selected, known as interest features, are listed below. These interest features and ecologically important components, termed sub-features, are described in more detail in Section 3. The distribution of these interest features together with the boundary of the Berwickshire and North Northumberland Coast European marine site is illustrated in Figure 3.

2.2 Interest features under the EU Habitats Directive

The Berwickshire and North Northumberland Coast qualifies as a SAC for the following Annex I habitats as listed in the EU Habitats Directive:

- **Reefs**;
- **Submerged or partially submerged sea caves** (referred to within this document as sea caves);
- **Mudflats and sandflats not covered by water at low tide** (referred to within this document as intertidal mudflats and sandflats).

The Berwickshire and North Northumberland Coast also qualifies as a SAC for the following Annex II species as listed in the EU Habitats Directive:

- **Grey seals *Halichoerus grypus***.

In many areas, breeding, hauling out and moulting occurs on habitats above the Highest Astronomical Tide and therefore outside the European marine site. As such, there are no specific objectives within this document for these habitats. Objectives to maintain these aspects of the grey seal habitat in favourable condition are found within English Nature's and Scottish Natural Heritage's conservation objectives for the relevant SSSIs within the SAC boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities need to have regard to such

adjacent European interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

2.3 Interest features under the EU Birds Directive

2.3.1 Lindisfarne

Lindisfarne qualifies as a SPA under the EU Birds Directive in that it supports:

- **Internationally important populations of regularly occurring Annex 1 species**;
- **Internationally important populations of regularly occurring migratory species**; and
- **An internationally important assemblage of waterfowl.**

Lindisfarne was classified a SPA in 1992 and it is that citation on which this advice is based. The site is also listed as a Ramsar site under the Ramsar Convention for its internationally important wetland status. The boundary of the Lindisfarne SPA is illustrated in Figure 2.

2.3.2 St Abbs Head to Fast Castle

St. Abbs Head to Fast Castle qualifies as a SPA for its internationally important breeding population of guillemot *Uria aalge* and for regularly supporting an internationally important assemblage of breeding seabirds comprising of the following eight species: guillemot *Uria aalge*; kittiwake *Rissa tridactyla*; razorbill *Alca torda*; shag *Phalacrocorax aristotelis*; fulmar *Fulmarus glacialis*; cormorant *Phalacrocorax carbo*; herring gull *Larus argentatus* and puffin *Fratercula arctica*.

The habitat required for these species to nest does not however, occur within the European marine site, and therefore is not dealt with as part of this document, as it occurs above Highest Astronomical Tide. Objectives to maintain the bird interests in favourable condition are found within Scottish Natural Heritage's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities will however, need to have regard to such adjacent European interests within the management scheme for the European marine site, as they might be affected by activities taking place within, or adjacent to the European marine site.

2.3.3 The Farne Islands

The Farne Islands qualifies as an SPA for regularly supporting internationally important populations of the following breeding Annex 1 species: common tern *Sterna hirundo*; arctic tern *Sterna paradisaea* and sandwich tern *Sterna sandvicensis,* and for regularly supporting an internationally important assemblage of breeding seabirds including the following nine species: common tern *Sterna hirundo*; arctic tern *Sterna paradisaea*; sandwich tern *Sterna sandvicensis*; roseate tern *Sterna dougallii,* shag *Phalacrocorax aristotelis;* kittiwake *Rissa tridactyla;* guillemot *Uria aalge*; puffin *Fratercula arctica* and eider *Somateria mollissima.*

As with St. Abbs Head to Fast Castle SPA, the habitat required for these species to nest does not however, occur within the European marine site, and therefore is not dealt with as part of this document, as it occurs above Highest Astronomical Tide. Objectives to maintain the bird interests in favourable condition are also found within English Nature's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities will again however, need to have regard to such adjacent European interests within the management scheme for the European marine site, as they might be affected by activities taking place within, or adjacent to the European marine site.

2.3.4 Northumbria Coast

The Northumbria Coast qualifies as a SPA for supporting internationally important populations of the following regularly occurring Annex 1 species: Purple sandpipers *Calidris maritima* and Turnstone *Arenaria interpres*. The site is also listed as a Ramsar site under the Ramsar convention for its internationally important wetland status.

The Northumbria Coast SPA overlaps with the Berwickshire and North Northumberland Coast SAC. However, as the majority of the area of the Northumberland Coast SPA occurs outside and to the south of the SAC and is partly under the jurisdiction of different competent authorities to that of the SAC. Objectives to maintain these bird interests in favourable condition are found within English Nature's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities will however, need to have regard to such adjacent European interests within the management scheme for the European marine site, as they might be affected by activities taking place within, or adjacent to the European marine site.

3 SAC Interest features

This section describes and explains the importance of the SAC interest features of the Berwickshire and North Northumberland Coast European marine site and is provided in support of the advice required under Regulation 33.

3.1 Reefs

3.1.1 General description

Reefs are rocky marine habitats or biological concretions that arise from the seabed (Brown *et al*., 1997). They are predominantly subtidal but may extend as an unbroken transition into the intertidal zone, where they are exposed to air at low water. The types of reef which characterise this interest feature include vertical rock walls, horizontal ledges, broken rock and boulder fields.

Rocky reef communities are characterised by attached algae and invertebrates, usually associated with a range of mobile animals such as crustaceans and fish. The diversity and composition of biological communities on the reefs are a direct result of variation in this habitat type and are influenced by a number of key environmental factors, for example, the coastal geology and hydrodynamic regime. Factors such as the level of wave exposure and the degree of immersion by the tide produce environmental gradients which limit biological distribution. The distribution of certain fauna and flora such as *Hiatella arctica*, are also restricted to particular rock types. Water movement is particularly important for animal and plant communities on the reefs. It provides suspended food for filter feeders and contributes to the effective dispersal and recruitment of the larvae of many marine species. The movement of water also limits the settlement of silt, which may lead to the clogging of gills and feeding organs of marine animals associated with reefs. Although the physical environment is largely responsible for determining the reef communities, biological influences, such as predator/prey interactions and competition, will further shape the community structure.

Further information on the characteristics and sensitivity of intertidal reef biotopes, infralittoral reef biotopes with kelp species and subtidal brittle star beds can be found in Hill *et al*. (1998), Birkett *et al*. (1998) and Hughes (1998) respectively.

3.1.2 Importance of the feature

Reef habitats, moderately exposed to waves, occur throughout this extensive and diverse stretch of coastline. The subtidal rocky reefs and their rich marine communities, together with the wide variety of associated intertidal reefs, are the most diverse examples found on the North Sea Coast (Brown *et al*., 1997). Their remarkably varied nature is due to the wide range of physical conditions in the area, from wave exposed locations on the open coast, to more sheltered reefs within the bays, to those parts of the reefs exposed to tidal currents in sounds and off headlands. As a consequence, reef habitats along the Berwickshire and North Northumberland Coast have a high diversity of communities and species. A large number of the species present are characteristic of cold water such as the anemone *Bolocera tuediae* and the bottle brush hydroid *Thuiaria thuja*, with some others reaching their southern or eastern limit of distribution such as the Devonshire cup coral *Caryophyllia smithii*. The location of the reefs within the Berwickshire and North Northumberland Coast European marine site are illustrated in Figure 3.

Along the Berwickshire and North Northumberland Coast, rock platforms extend offshore as a series of reefs and rocky plains. These platforms extend several kilometres out to sea as a series of underwater terraces. Although this part of the coast is exposed to the full fetch of the North Sea from the east or north-east, the wave action is rapidly attenuated on the more extensive wave cut, rocky platforms allowing a wide range of animal and plant communities to live in close proximity. One of the best examples of this in the site is found at Longhoughton. This wide expansive wave cut rocky platform (Longhoughton Steel), together with the 2km of shore to the south, form the largest extent of uninterrupted littoral bedrock in this

area, extending at least 0.5km seawards from the high tide mark. The terrain here is very rugged, with long ridges and pools running both perpendicular and parallel to the coast providing numerous niches for a variety of marine fauna and flora.

The substrata of the rocky reefs on the Berwickshire and North Northumberland Coast European marine site is extremely diverse and ranges from soft limestone bored by the bivalve *Hiatella arctica*, to hard volcanic rock (for example, whin sill) pitted by erosive forces of the sea. The Farne Islands are of particular importance as they are the only rocky islands with extensive reefs in the North Sea. Here the whin sill overlies layers of sandstone and limestone. The limestone is particularly species rich and bored by hydroids and bryozoans. In siltier areas it is colonised by the rare erect bryozoan *Smittina landsborovii*. The structure of reef biotopes in the Berwickshire and North Northumberland Coast European marine site are detailed further in Foster-Smith (1998) and Brazier *et al*. (1996).

3.1.3 Sub-features

The rocky reefs of the Berwickshire and North Northumberland Coast European marine site are rich in species with a high diversity of reef communities. For the reefs interest feature on this site, the following sub-features are identified: rocky shore communities; kelp forest communities; and sublittoral faunal turf communities.

Rocky shore communities – The intertidal rocky reefs of the Berwickshire and North Northumberland Coast European marine site support a diverse range of habitats, including extensive rock pool systems and boulder shores. This diversity is due primarily to the different rock types and structures within the site such as whin sill and limestone reefs at Newton Haven. The shores associated with headlands and islands such as those at St Abb's Head and the Farne Islands are mainly steep and subject to strong wave surge conditions. The resultant high splash zone dominated by grey and orange lichens and black lichen *Verrucaria maura* in the littoral fringe, form distinctive broad bands under these high energy conditions. The upper and middle areas of these shores are typically covered by barnacles *Semibalanus balanoide*s and mussels *Mytilus edulis*, or limpets *Patella vulgata*, amongst which grow short plants of the red algae *Mastocarpus stellatus* and *Ceramium* spp. On the lower parts of these shores, *S. balanoides* is replaced by *Balanus crenatus* with a greater density of red algae (Brazier *et al*., 1996).

The majority of the rocky shores in the site, are gently sloping bedrock or boulder shores. There is an extensive example of such a bedrock platform at Boulmer Steel, just north of Alnmouth, where the majority of the intertidal zone is dominated by fucoid algae. The large extent of these shores result in reduced mid and upper shore areas, with dissipated wave action allowing the fucoids, typical of more wave sheltered shores, to maintain a firm attachment. Where sediments are adjacent to sheltered or moderately exposed rocky shores, sand deposited on the shore is often bound by the filaments of the red alga *Audouinella* spp.

The main rocky shore biotopes (summarised in Table 1 of Appendix 1) provide ideal habitats for brown algae such as *Fucus* spp., red algae such as *Porphyra* spp., pink coralline crusts, coral weed *Corallina officinalis*, the less common china limpet *Patella ulyssiponensis*, kelps *Laminaria* spp. and shanny *Lipophrys pholis*.

In the rocky shore the predominant environmental gradients which limit the boundaries of biological distribution are wave exposure and desiccation. This has a significant structuring effect on reef communities, affecting both the type and vertical/horizontal zonation of species. The more exposed shores, such as the coastline from Fast Castle Head to Eyemouth, tend to be animal dominated, whilst more sheltered rocky shores such as at Newton Haven, tend to be dominated by algae. Fucoid dominated algal communities such as these provide a significant contribution to the primary production within the reef system. The highly diverse and abundant marine communities found on rocky shores also provide an important source of food for predators such as foraging fish, crustaceans and birds.

Kelp forest communities - Much of the open coast within the Berwickshire and North Northumberland Coast European marine site is fringed by dense kelp forest communities. Kelp species such as *Laminaria*

hyperborea, which occur in the sublittoral fringe but is mostly found subtidally, support a rich understorey of red algal turf and short epifaunal turf. Beyond this fringing area, reefs in over 10m depth of water, are characterised by urchin grazed kelp habitats, small crabs, squat lobsters and the anenomes such as *Urticina felina.* The main sublittoral kelp biotopes are summarised in table 2 in Appendix 1.

Kelp forests are highly productive ecosystems, contributing significantly to the primary production in coastal waters in the UK. It is estimated that 90% of kelp production enters detrital food webs of coastal areas, supporting habitats just beyond the kelp beds (Birkett *et al*., 1998). Kelp forests are also of considerable conservation value because they harbour a wide variety of plants and animals. For example, a single kelp holdfast may be home to several thousand small animals such as colonial sea squirts such as *Botrylloides leachi* and sponges such as *Leucosolenia* spp. The stipes of the kelp plants are often well covered with the bryozoan *Electra pilosa* and numerous foliose and filamentous red algal species including dulse *Palmaria palmata* and *Plocamium catilagineum,* as well as a range of invertebrates. Beneath the kelp canopy, bedrock sponges, bryozoans such as *Bugula* spp., sea squirts and red algae such as sea beech *Delesseria sanguinea* dominate. Grazing by the sea urchin *Echinus esulentus* within the kelp forest reduces species richness and leaves rock surfaces covered by pink coralline algal crusts and the keel worm *Pomatoceros triqueter*. The habitat also plays a significant role as a nursery area for a wide variety of species and provides essential shelter and feeding grounds for a range of mobile species such as the cuckoo wrasse *Labrus mixtus*. The kelp forest communities are therefore considered to be key structural and functional components of the reefs within the Berwickshire and North Northumberland Coast European marine site.

An important factor in determining the depth to which kelp grows is water clarity. The turbidity of the water influences the depth at which algal species grow in the nearshore by limiting light penetration through the water and hence photosynthesis by the plants. St Abbs is renowned for its good water clarity and noted by many divers who visit the area although there have been reports of deterioration in water clarity in recent years. Estimates of underwater visibility range from approximately 2 to 20m depending on weather and sea conditions. Kelp forests flourish to at least 8m below chart datum, which is a good indicator of a generally low water turbidity for the north east of England and south east of Scotland.

Subtidal faunal turf communities - Where kelp communities and other algae are unable to establish, primarily due to the lack of sufficient light penetration, faunal turf communities tend to dominate the reefs, forming a species rich and structurally and functionally important component of the reef ecosystem. This living turf comprises diverse assemblages of attached animals growing on subtidal substrata, ranging from encrusting forms such as sea mats and sponges, to tall erect soft corals and sea fans. These communities also include prominent mobile species, associated with the attached fauna, such as crustaceans, echinoderms, molluscs and fish, some of which are commercially important. By definition, faunal turf communities are animal dominated, although there will be foliose and crustose red algae present in the upper regions of this zone where it overlaps with the shallower infralittoral zone. In contrast to intertidal substrata, zonation of subtidal communities is very much broadened with fewer areas of the reef tending to be dominated by a single species. The boundaries of the faunal turf communities and the kelp forest are also often blurred.

Rock pinnacles, bedrock terrace, boulder fields, ledges and gullies on and within the reef tend to be colonised by the short faunal turfs consisting of sponges, hydroids (sea firs), polychaetes, bryozoans (sea mats), anemones and soft corals. Vertical rock walls are often covered in the soft coral *Alyconium digitatum* (dead mans fingers) and the hydroid *Tubularia indivisa*. At the Farne Islands and St Abbs Head for example, dense beds of dead mans fingers *Alcyonium digitatum*, plumose anemones *Metridium senile*, the hydroid *Tubularia larynx* and a short turf of bryozoans and ascidians attach firmly to the rock and kelp plants, withstanding the strong wave surge conditions (Brazier *et al*, 1996). Areas of tideswept bedrock and mixed substrata such as cobble and gravel plains, support dense growths of *Alcyonium digitatum*, whilst the siltier areas favour bryozoans such as *Flustra foliacea.* Brittlestars also colonise the subtidal reefs and are found all along the coastline of this site. It has been suggested by Foster Smith (1998) that brittlestar beds are important to the ecological dynamics of the reef community. The main biotopes found in the sublittoral faunal turf biotope complex are summarised in Table 3 in Appendix 1.

3.2. Intertidal mudflat and sandflat communities

3.2.1. General description

Intertidal mudflats and sandflats are sediment habitats which are submerged at high tide and exposed at low tide. They form a major component of estuaries and embayments in the UK but also occur along the open coast. The physical structure of the intertidal flats can range from the mobile, coarse sand beaches of wave exposed coasts, to the stable, fine sediment mudflats of estuaries and embayments. This habitat type can be divided into three broad categories; clean sands, muddy sands and muds although there is a continuous gradient between them. The faunal and plant communities present vary according to the type of sediment, its stability and the salinity of the water.

Physical factors such as the hydrodynamic regime (tides, waves, residual currents) together with the underlying geomorphology and geology of the area create the conditions for a given type of substratum to develop. These characteristics are intimately related and will determine which biological communities will occur there. Biological distribution is determined primarily by physical factors, but also by biological influences which further shape community structure. Mudflats and sheltered intertidal sandflats reflect low energy conditions which are characterised by particles of small-medium diameter, a shallow slope, a high water and organic content and therefore high reducing conditions. This sediment is stable and favours the establishment of tube dwelling polychaetes together with large numbers of infaunal bivalves (Atkins, 1983). Exposed intertidal sandflats occur in high energy areas and are characterised by sediment particles of high-medium diameter, a high permeability, a low organic content and a high oxygen content and therefore low reducing conditions. This sediment has a low stability which results in a lower biological diversity than the more sheltered shores. There may be an absence of sedentary organisms such as bivalve molluscs and a dominance of agile swimming organisms such as small burrowing amphipods. These species tend to have a short lifespan and are characterised by their ecological flexibility (McLachan, 1993). Further information on the characteristics and sensitivity of intertidal mudflats and sandflats can be found in Elliot *et al*. (1998).

3.2.2 Importance of the feature

The Berwickshire and North Northumberland Coast European marine site contains a very extensive and varied range of intertidal mudflats and sandflats important for their biological diversity and extent. These habitats range from wave exposed mobile coarse sand to sheltered fine sediments rich in faunal communities. The intertidal sediments in the Lindisfarne and Budle Bay estuary and on the adjacent open coast to the north of the island for example, are the most extensive in the north east of England, with an area of nearly 3 km^2. These sediments are host to the largest intertidal beds of the narrow leaved eelgrass *Zostera angustifolia* and dwarf eelgrass *Z. noltii* on the east coast of England as well as diverse infaunal communities and large beds of mussels *Mytilus edulis*. Wintering geese and wigeon rely on the eelgrass beds for feeding when they arrive in early autumn whilst wading birds feed on invertebrates in and on the sediment such as the abundant lugworm *Arenicola marina*.

Some of the bays along the open coast of the Berwickshire and North Northumberland Coast European marine site consist of fairly mobile sand, with populations of sandeel *Ammodytes* spp., small crustaceans and polychaete worms. These communities are important in supporting predator communities such as mobile macrofauna, juvenile fish and overwintering and migrating wading birds. More sheltered sediments on the site have very stable lower shore communities which include bivalve molluscs. At Newton Haven the burrowing heart urchins *Echinocardium cordatum* can also be found which is usually only found in subtidal areas. The structure of sediment biotopes at Lindisfarne and Budle Bay are detailed further in a Lindisfarne biotope survey report (Allen *et al*. 1999) The location of intertidal mudflat and sandflat areas are illustrated in Figure 3 and the biotopes typically found in these habitats are summarised in Appendix 2.

3.2.3 Sub-features

Four main sub-features can be identified for the intertidal mudflats and sandflats interest feature on the

Berwickshire and North Northumberland Coast European marine site:

Sand communities - The coastline within the site has very little natural shelter apart from that provided by outlying rocks and low headlands, such as those at Newton and Boulmer Haven, which protect small areas of sandy beach. The beach of very fine sand at Newton Haven is of particular interest for its lower shore biotopes of the burrowing heart urchin *Echinocardium cordatum*, razor clams *Ensis* spp., a variety of bivalves and polychaetes and sparse numbers of the urchin *Echinocardium flavescans* (Foster-Smith and Foster-Smith, 1987; Olive, 1984). The exposed and uniform nature of Budle Bay results in a low habitat diversity, indeed, only four biotopes have been recorded there. The clean, well-sorted sand is characterised by the robust polychaetes *Paraonis fulgens* and *Scolelepis squamata*.

The coastline between Fast Castle Head and the Tweed estuary is very wave exposed and there are few sediment habitats with the exception of small sandy shores at Coldingham Bay and Eyemouth. The high sediment mobility reduces the diversity of the infaunal communities present, which tend to be characterised by sparse robust polychaetes and amphipods.

Mobile sands areas such as at Cheswick and Goswick Sands or Embleton and Beadnell Bay support crustacean and polychaete dominated biotopes, with few species other than the lugworm *Arenicola marina*, burrowing amphipods such as *Bathyporeia* spp. and the sand eel *Ammodytes tobianus*.

Mud and muddy sand communities – Mud and muddy sand habitats within the site, such as those at Lindisfarne, support an exceptionally high biomass of macrofauna which in turn support large numbers of feeding birds, fish and mobile macrofauna. The intertidal sediments at Lindisfarne and Budle Bay area are the most extensive areas of mud and muddy sands within the site. This is one of only two barrier beach systems in the UK and supports a very high abundance of invertebrates, the largest intertidal eelgrass beds on the east coast of England, and the infauna within the sediments provide food for a range of internationally important birds. The more sheltered area of flat muddy sand in the west of Budle bay is characterised by the polychaetes *Scoloplos armiger, Pygospio elegans, Capitella capitata* and *Arenicola marina*, oligochaetes *Heterochaeta costatus, Tubificoides benedii, T. pseudogaster* and enchytraeids and the amphipod *Corophium volutator*. Bivalves, including thin tellin *Angulus tenuis*, Baltic tellin *Macoma balthica* and *Abra tenuis*, have also been recorded in these more sheltered areas. In recent years there has been a progressive development of annual *Entermorpha* blooms at Lindisfarne and Budle Bay, which can be indicative of nutrient enrichment.

The mudflats at Boulmer Haven, although relatively small compared to Lindisfarne, are comparatively rich in terms of species abundance and diversity. Lugworms *Arenicola marina*, are abundant and occur alongside a variety of other polychaete worms, including *Eteone longa*, and the bivalves *Fabulina fabula* and *Macoma balthica*. Lower on the same shore, the slightly coarser and cleaner muddy sand supports dense sand mason worms *Lanice conchilega* and polychaete *Eumida* spp., as well as large numbers of bivalves; *Fabulina fabula, Lucinoma borealis, Abra alba* and *Abra prismatica*.

Mussel bed communities - In areas on the east side of Fenham Flats, Budle Bay and south and west of Holy Island where a degree of shelter is provided, mussels *Mytilus edulis* have colonised the sediment surface where scattered pebbles and shells provide stability for attachment and growth. The mussel beds established provide an important anchorage for fucoid algae and other marine species, and help to stabilise the sediment, establishing a biogenic reef habitat for a range of marine species. The mussels and other organisms they harbour, provide an important food supply for marine predators such as crustaceans, echinoderms, fish and birds.

Eelgrass communities - Eelgrass bed communities are an important component of the intertidal mudflats and sandflats on the Berwickshire and North Northumberland Coast European marine site. These rare communities are not only important as a habitat for a diverse community of small animals and plants but also as spawning and nursery areas for various fish species. Eelgrass beds provide an important feeding ground in which waders feed on invertebrates and as a food source for waterfowl such as brent geese. Eelgrass beds also stabilise the sediment and contribute greatly to productivity of the mud flat.

The eelgrass *Zostera noltii* and *Zostera angustifolia* cover the fine muddy sand on the west and south west of Fenham Flats, forming the largest area of this biotope on the northeast coast of England and Scotland. The fauna within this biotope includes a high diversity of polychaetes and molluscs, some of which are absent or found only in small numbers elsewhere on the north-east coast of England. For example, the polychaete *Galathowenia oculata* and the sea slug *Akera bullata* are found in relatively large numbers in this area compared to the rest of the Northumbrian coast.

Eelgrasses were once abundant and widespread around the British coast, but serious declines have occurred, in particular as a consequence of a severe outbreak of 'wasting disease' in the early 1930s. Recovery of eelgrass beds since the 1930s has been slow and patchy, and this community is now considered nationally scarce in the UK. A Biodiversity Habitat Action Plan (HAP) has been identified for eelgrass beds.

3.3. Sea caves

3.3.1. General description

The UK has the most varied and extensive sea caves on the Atlantic coast of Europe. Sea caves include tunnels, caverns and arches on the shore or below the sea surface, in which vertical or overhanging rock provides surfaces for cave communities. Caves vary in size, from only a few metres, to more extensive systems which may extend hundreds of metres into the rock. Caves in the intertidal and shallow subtidal are frequently subject to conditions of strong wave surge and scour by coarse sediment. They are typically colonised by encrusting animal species but may also support shade-tolerant algae near their entrances and roofs. As on rocky shores, the presence of pits, crevices and marine flora within cave habitats, leads to an increase in microhabitats and a higher diversity of species. Water movement allows nutrients and larvae to be transported, as well as maintaining levels of dissolved oxygen and preventing siltation of organisms. However, water movement can also result in a sand-scoured environment with the potential to dislodge organisms.

The degree of immersion and exposure to wave action are key determinants in the distribution of marine organisms in cave habitats. Some of the caves are submerged at all stages of the tide whilst others dry out at low water, or are heavily influenced by wave splash and salt spray from the sea. Cave community structure will also vary considerably depending on the formation and extent of the cave system, the degree of exposure to scour and surge, and the nature of the bedrock. 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 within the caves. Light availability and immersion gradients are the principal factors influencing the distribution of the lichen and algal communities which themselves are a significant source of food for grazing marine animals such as limpets and sea snails.

3.3.2. Importance of the feature

Berwickshire and North Northumberland Coast European marine site is noted for its extensive and highly diverse sea caves within the intertidal or in shallow water, occurring in a range of different types of rock. There are examples of partly submerged caves in the softer sandstone cliffs north of Berwick upon Tweed, in the limestone at Howick and on the north side of Lindisfarne. Submerged sea caves, tunnels and arches occur in the harder volcanic rock around St. Abbs, and near the Farne Islands.

Sea caves 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. Caves that are subject to such strong wave surge are often characterised by communities of mussels *Mytilus edulis*, barnacles *Balanus crenatus*, cushion sponges, encrusting bryozoans and colonial sea-squirts, depending on the degree of water movement and scour at particular points in the cave system. Depending on the location of the cave in relation to tidal height and its morphology, a distinct range of biological communities are supported, many with a characteristic horizontal and vertical zonation, shaped by a variety of primarily physical, but also biological factors. In partly submerged caves the communities exhibit a characteristic zoning from the entrance where algae tends to dominates, to the shaded roof and

back wall of the cave, which is often colonised by ascidians such as *Dendrodoa grossularia* and the purse sponge *Grantia compressa*. Here there is often insufficient light for photosynthetic algae to survive. The location of sea caves on the Berwickshire and North Northumberland Coast European marine site is illustrated in Figure 3.

3.3.3 Sub-features

Sea caves at this site are classified as either intertidal (partially submerged at some stage in the tidal cycle) or subtidal (submerged at all times). Each of these types of sea cave support a highly diverse assemblage of sea cave biotopes with characteristic zonation patterns.

Intertidal sea cave communities - Sea caves which occur above the low water mark are subject to varying degrees of tidal inundation and splash from waves. The communities within these caves tend to be dominated by species which are tolerant of high energy water movement and exposure to the air. The walls of upper shore caves such as those found between Berwick upon Tweed and Howick Haven, are often colonised by a variety of microalgal and lichen communities where they are infrequently covered by the tide but tend to remain damp in the shade of the cave. These algal and lichen communities are a valuable source of primary productivity and are grazed upon by invertebrate species, such as limpets *Patella vulgata* and periwinkles *Littorina* spp. The floors of these caves are commonly composed of coarse sediment, cobbles and boulders, many of which can be highly mobile and can scour the cave walls. Depending on the degree of water movement and scour, mussels *Mytilus edulis*, barnacles *Balanus crenatus*, cushion sponges, encrusting bryozoans and colonial sea squirts may also occur.

In caves within the mid and lower shore areas, the communities exhibit a characteristic vertical and sometimes horizontal zoning from the entrance, where algae dominates, to the shaded roof and back wall of the cave where ascidians such as *Dendrodoa grossularia* and the purse sponge *Grantia compressa* may occur. Algal turfs on the walls within the entrance usually include the sand encrusting red algae *Audouinella* spp. which forms a dense dark red mat on the surface of the rock. Within the caves on vertical and overhanging walls, similar algal-dominated biotopes to those seen in the mid to lower shore overhangs often occur, with a progression to sponge, hydroid, anemone and ascidian communities inside. The caves in the intertidal provide damp sheltered conditions that would not ordinarily be present on these areas of the shore.

Intertidal sea caves are found throughout the Berwickshire and North Northumberland Coast European marine site, for example, the steep rocky shores between Fast Castle Head and the volcanic outcrop at St. Abbs head, where erosion of soft rock intrusions within volcanic layers has created a series of narrow gullies, many leading to caves. There are also notable examples of intertidal sea caves in the sandstone cliffs to the north of Berwick upon Tweed, in the limestone at Howick and on the north side of Lindisfarne. A list of intertidal sea cave biotopes is given in Table 1 in Appendix 3. Further information detailing the intertidal cave biotopes in the Berwickshire and North Northumberland Coast European marine site can be found in Environment Resource Technology (1997). A survey to establish baseline information and to test monitoring methodology is currently being undertaken (in Environment Resource Technology, in prep.).

Subtidal sea cave communities - Caves that occur in the subtidal are continually submerged in water and are not exposed to the air at low tide. There are good examples of subtidal sea caves, tunnels and arches in the volcanic rock around St Abbs and off the Farne Islands. Environmental conditions in these caves are not as harsh or extreme as in the intertidal sea caves and tend therefore to support a wider range of species. Subtidal sea caves are subject to less water movement from the surrounding sea than intertidal caves, and silt may accumulate on the cave floor. The sponges *Dercitus bucklandi* and *Thymosia guernei*, soft corals, solitary sea-squirts, bryozoans and sessile larvae of jellyfish are characteristic of deeper cave systems. Caves such as these provide an important source of shelter for crustaceans such as crabs and lobsters *Homarus gammarus*, and for a variety of reef-dwelling fish, such as the leopard-spotted goby *Thorogobius ephippiatus*. Within moderately exposed reef systems such as occur within the Berwickshire and North Northumberland Coast European marine site, the shelter afforded by subtidal caves is an important structural and functional component of the ecosystem.

A list of subtidal sea cave biotopes is given in Table 2 in Appendix 3. Further information detailing the subtidal cave biotopes in the Berwickshire and North Northumberland European marine site can be found in ERT (1997). A survey to establish baseline information is currently being undertaken (in Environment Resource Technology, in prep.).

3.4 Grey seal *Halichoerus grypus*

3.4.1 General description

The UK holds some 114,000 grey seals, approximately 33% of the world population and 95% of the European population (NERC, 1998). Based on pup production, the largest grey seal breeding colonies in the UK have been selected to ensure coverage of the geographical range of their breeding in the UK. The grey seal is Britain's largest carnivore. They divide their time between land, where they breed, moult and rest, and the sea where they forage, rest and play.

3.4.2 Importance of the feature

The Berwickshire and North Northumberland Coast European marine site contains one of the largest breeding colony of grey seals on the North Sea coast. This is the most south-easterly of the grey seal breeding sites selected in the UK and encompasses some 3% of the British annual pup production (Brown *et al*, 1997).

The Farne Islands are particularly important as they constitute the eighth largest grey seal breeding colony in the UK, producing around 1000 pups annually (NERC, 1998). The islands provide suitable sheltered and undisturbed habitat for pupping, which occurs during the autumn, and for moulting which occurs for most grey seals during the spring. The suitability and accessibility of pupping areas as well as haul-out areas are critical for the survival and continued presence of the population of grey seals within the Berwickshire and North Northumberland Coast European marine site.

There is evidence to suggest that grey seals feed over a large area of the North Sea (and further afield) at varying times of the year. However, areas close to the Farne Islands characterised by gentle sloping banks of gravely sand are particularly frequented by grey seals. These areas also tend to be the preferred habitat of sandeels (*Ammodytes* spp.), one of the preferred food sources of grey seals in the area

In recognition that grey seal populations may change as a reflection of national or international trends or events, the conservation objective for this species at a site level focus on maintaining the condition of the habitats used by the grey seals. Habitat condition will be delivered through appropriate site management including the avoidance of disturbance. In reporting on favourable conservation status, account will need to be taken both of habitat condition and the status of the grey seals within the SAC.

Accordingly, English Nature and Scottish Natural Heritage will use periodic counts, together with available information on population and distribution trends, to assess whether the SAC is continuing to make an appropriate contribution to the favourable conservation status of the species. Count information will be assessed in combination with information on habitat condition, at the appropriate time within the reporting cycle, in order to report to the European Commission.

In addition to focusing on avoiding deterioration to the habitats of the qualifying species, the Habitats Directive also requires that actions are taken to avoid significant disturbance to the species for which the site was designated. Such disturbance could result in alterations in population trends and/or distribution patterns. Avoiding disturbance to species requirements is mentioned in the favourable condition table underpinning the conservation objective for grey seals. In this context, periodic count information on populations will be used as the basis for assessing whether disturbance is damaging.

As with SAC Annex I habitat interest features, sub-features are identified which describe the key habitats within the European marine site necessary to support the grey seal breeding population. Detailed

information on targets for habitat condition are listed in the favourable condition table in Section 6. Breeding habitats of particular importance are indicated in Figure 4.

3.4.3 Sub-features

Rocky and coarse sediment shores – On the Farne Islands in particular, rocky shores provide crucial habitats for grey seal breeding. The annual breeding season for grey seals at the Farnes extends from mid September through to early December. Adult females spend approximately three weeks ashore or in the shallow waters near the shores where their pups remain until weaned. Adult males may spend anything from a few days to nearly two months on breeding islands attempting to mate. Shore areas also provide an important habitat throughout the year for grey seals to haul-out or rest, particularly during the spring when all grey seals, except young born the previous year, are moulting. It is therefore important that the suitability and accessibility of this habitat to grey seals is maintained. Throughout the year and during the breeding period in particular, grey seals also spend a large proportion of their time in waters within the European marine site, particularly near the shore, often foraging for food or resting. There is also a notable haulout area (approximately one hundred grey seals) on the sandbanks to the west of Lindisfarne.

4 SPA interest features

This section describes and explains the importance of the SPA interest features of the Berwickshire and North Northumberland Coast European marine site and is provided in support of the advice required under Regulation 33 (2).

4.1 Background and context

A major aim of the Birds Directive is to take special measures to conserve the habitats of qualifying wild birds in order to ensure their survival and reproduction within the European Union. A key mechanism in achieving this is the classification by Member States of the most suitable sites as SPAs.

English Nature and Scottish Natural Heritage's conservation objectives at a site level focus on maintaining the condition of the habitats used by the qualifying species. Habitat condition will be delivered through appropriate site management including the avoidance of damaging disturbance. In reporting on Favourable Conservation Status, account will need to be taken both of habitat condition and the status of the birds on the SPA.

Accordingly, English Nature and Scottish Natural Heritage will use annual counts, in the context of five year peak means for qualifying species, together with available information on population and distribution trends, to assess whether an SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species. Count information will be assessed in combination with information on habitat condition, at the appropriate time within the reporting cycle, in order to report to the European Commission

English Nature and Scottish Natural Heritage's advice focuses on the qualifying species for which the SPA was originally classified despite the fact that numbers and species composition may have changed on this site since that time. Such population and species composition changes are being documented through the UK SPA Network Review, led by JNCC, which will provide advice to Ministers on any changes in SPA citations required. Depending on the review and decisions from DETR or the Scottish Executive, English Nature and Scottish Natural Heritage may reissue this advice on SPAs with updated bird information.

In addition to focusing on avoiding deterioration to the habitats of the qualifying species, the Habitats Directive also requires that actions are taken to avoid significant disturbance to the species for which the site was designated. Such disturbance may include alterations in population trends and/or distribution patterns. Avoiding disturbance to species requirements is mentioned in the favourable condition table underpinning the conservation objectives for the SPA. In this context, five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.

Attention is, however, also directed to the inclusion of disturbance in the advice on operations provided in Sections 7 and 8. Where disturbance is highlighted in such advice, relevant authorities need to avoid damaging disturbance to qualifying species when exercising their functions under the Directive.

4.2 Definition

The Lindisfarne SPA (classified a SPA in 1992), the boundary of which is shown in Figure 2 qualifies under Article 4.1 of the EU Birds Directive by supporting:

- internationally important populations of the following regularly occurring Annex 1 species: golden plover *Pluvialis apricaria*, whooper swan *Cygnus cygnus*, little tern *Sterna albifrons* and roseate tern *Sterna dougallii*.

It also qualifies under Article 4.2 of the EU Birds Directive by supporting:

- internationally important populations of the regularly occurring migratory species: greylag goose *Anser anser*, light-bellied brent goose *Branta bernicla hrota*, wigeon *Anas penelope*, ringed plover *Charadrius hiaticula*, bar-tailed godwit *Limosa lapponica* and redshank *Tringa trotinus*; and

- an internationally important assemblage of wintering waterfowl (greater than 20,000 birds).

Lindisfarne was also designated a Ramsar site in 1976 for meeting the following criteria:

- containing extensive intertidal flats together with a large area of saltmarsh and major sand dune system with well developed dune slacks;

- supporting an internationally important wildfowl assemblage (greater than 20,000 birds); and

- regularly supporting internationally important overwintering populations of: greylag goose *Anser anser*, light-bellied brent goose *Branta bernicla hrota*, wigeon *Anas penelope*, bar-tailed godwit *Limosa lapponica*, ringed plover *Charadrius hiaticula* and redshank *Tringa trotinus*.

Details on the population size and thresholds of the qualifying species for which the SPA was originally classified and on which this advice focuses, are a given in Table 1. As with SAC interest features, sub-features are identified which describe the key habitats within the European marine site necessary to support the birds that qualify within the SPA. Detailed information and targets for habitat condition are listed in the favourable condition table in Section 6. Further information on the key habitat requirements for the qualifying species can be found in Kirby and Chivers (1999).

4.3 Importance of the internationally important populations of regularly occurring Annex 1 species

The Lindisfarne SPA citation lists four regularly occurring Annex 1 bird species which the site supports: golden plover *Pluvialis apricaria*; whooper swan *Cygnus cygnus*; little tern *Sterna albifrons*; and roseate tern *Sterna dougallii*.

Golden plovers *Pluvialis apricaria* overwinter on the site in internationally important numbers, arriving at Lindisfarne in the autumn, when they feed on a range of invertebrates in permanent pastures near the SPA. As night falls however, they return to roosts on the intertidal mudflats and sandflats within the Berwickshire and North Northumberland Coast European marine site. In early March/April they leave for their breeding grounds in upland areas of England and the tundra of Scandinavia and Siberia. Whooper swans *Cygnus cygnus* also overwinter at Lindisfarne, usually arriving from Iceland in early-mid October. During the winter period whooper swans forage in areas with emergent and submerged plants, such as saltmarshes and eelgrass beds, moving to open water to roost.

During the summer months, little terns *Sterna albifrons* breed at Lindisfarne and feed on small fish and crustaceans in the shallow intertidal waters within the Lindisfarne SPA. Nesting occurs above the high water mark on shingle spits and in sand dunes and therefore outside the boundary of the Berwickshire and North Northumberland European marine site. Objectives to maintain this aspect of bird interest are found within English Nature's and Scottish Natural Heritage's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities need to have regard to such adjacent European interests, as they might be affected by activities taking place within, or adjacent to the European marine site. The roseate tern *Sterna dougallii* is a particularly rare species and has similar nesting and feeding requirements to the little tern.

4.3.1 Sub-features

Intertidal mudflats and sandflats - the mudflats and sandflats at Lindisfarne are a particularly important roosting area for golden plover *Pluvialis apricaria*.

Eelgrass beds - the eelgrass communities at Lindisfarne are important overwintering habitats for whooper swans as they graze on the submerged or emergent plants.

Saltmarsh – the saltmarsh communities at Lindisfarne are important for foraging whooper swans.

4.4 Importance of the internationally important populations of regularly occurring migratory species

Lindisfarne SPA supports internationally important populations of six regularly occurring migratory species. The site is particularly important for supporting an population of the Icelandic greylag goose which overwinters entirely in Britain, and for supporting internationally important numbers of the Svalbard light- bellied brent goose, 75% of the world population of which overwintered in Britain at time the SPA was designated. The majority of the overwintering population of light-bellied brent geese breed in Svalbard, moving to Danish and Dutch wintering grounds in September and subsequently on to Lindisfarne. They usually move back to Denmark and Holland in February to continue feeding, then fly to their breeding grounds in Svalbard in May. They feed on saltmarsh plants, eelgrass *Zostera* spp. and green seaweeds as well as on cereals and grass in nearby farmland. The geese roost communally on sheltered coastal and estuarine waters. This is one of the few sites in Britain still regularly used by light-bellied brent geese and the large areas of eelgrass, including narrow-leaved and dwarf eelgrass provides an important source of food. Greylag geese will graze on the green ephemeral algae *Entermorpha* spp. which occurs on the surface of mudflats within the site. Greylag geese also feed on nearby arable fields, grassland and shallow water, roosting in nearby, usually on estuaries or fresh water lakes and reservoirs. Wigeon *Anas penelope*, bar-tailed godwit *Limosa lapponica*, redshank *Tringa totanus* and ringed plover *Charadrius hiaticula* also overwinter at Lindisfarne with the eelgrass, invertebrate and saltmarsh communities supported by the extensive intertidal mudflats and sandflats providing an important food source for these species.

4.4.1 Sub-features

Intertidal mudflats and sandflats - the mudflats and sandflats at Lindisfarne support communities which provide a valuable food source as well as acting as a refuge for roosting birds. The mudflat communities at Lindisfarne are extremely important overwintering habitats for bird populations such as the light-bellied brent and Greylag geese. Redshank and bar-tailed godwit spend a large proportion of their time probing the intertidal sediment for invertebrates, such as worms, crustaceans and molluscs.

Eelgrass beds – The eelgrass communities at Lindisfarne are extremely important overwintering habitats for several bird populations, particularly light-bellied brent and greylag geese and wigeon. Both the narrow-leaved and dwarf eelgrass are grazed by these bird populations.

Saltmarsh – Saltmarsh communities, particularly *Salicornia* spp. are important food sources for migratory bird populations within the site, such as the light bellied geese and wigeon. Saltmarsh areas are also used as a refuge for roosting birds.

4.5 Importance of the internationally important assemblage of waterfowl

Lindisfarne also qualifies as a SPA for regularly supporting an assemblage of over 20,000 wintering waterfowl which includes the internationally important regularly occurring migratory species. Over 30,000 individuals of sixteen species feed and roost within the site. Bird communities are highly mobile and exhibit patterns of activity related to tidal water movements and many other factors. Different bird species exploit different parts of the European marine site and different prey species within it. Changes in the habitat may therefore affect their prey availability. The bird populations making up the internationally important assemblage therefore require a hydrophysical regime which is capable of maintaining the physical integrity of their habitat. Factors important to this include; the current extent and distribution of suitable feeding and roosting habitat (e.g. saltmarsh, eelgrass Z*ostera* spp. beds, mudflats); sufficient food availability (e.g. small fish, crustaceans and worms); minimal levels of disturbance; and water quality (including salinity and minimal pollution) necessary to maintain inter-tidal plant and animal communities and to maintain ecological conditions suitable for bird feeding and roosting.

4.5.1 Sub-features

Saltmarsh - as with the Annex 1 and migratory birds already mentioned, the saltmarsh communities provide a roosting and feeding habitat for a range of waterfowl. For example, wigeon feed on the pioneer saltmarsh species such as *Salicornia* spp.

Intertidal mudflats and sandflats - the mudflats and sandflats at Lindisfarne provide a valuable and varied feeding habitat for the internationally important assemblage of birds as well as acting as a refuge for roosting birds. Sanderling for example, use sandy beaches within the site, whilst pelagic sea birds, such as the common scoter, feed on the invertebrates in shallow, inshore waters.

Rocky shore - the intertidal rocky areas at Lindisfarne provide an important food source and roosting area for a range of birds.

Eelgrass communities - as with the Annex 1 and migratory birds mentioned previously, eelgrass communities at Lindisfarne provide a feeding habitat for a range of waterfowl such as light-bellied brent goose and wigeon.

5 Conservation objectives

This section is provided in compliance with Regulation 33 (2)(a) of The Conservation (Natural Habitats, &c.) Regulations 1994.

Under Regulation 33 (2)(a), English Nature and Scottish Natural Heritage have a duty to advise other relevant authorities as to the conservation objectives for the European marine site. The conservation objectives for the Berwickshire and North Northumberland Coast European marine site are provided below and should be read in the context of other advice given in support of these objectives, particularly:

- the attached maps showing the extent of the various interest features and sub-features;
- summary information on the interest of each of the features; and
- the favourable condition table providing information on how to recognise favourable condition for each of the features and which will act as a basis from which the monitoring programme will be developed.

5.1 SAC interest features

5.1.1 The conservation objective for reefs

Subject to natural change, maintain in favourable condition[5] the **reefs**, in particular:

- The extent, distribution, diversity and species richness of reef communities.

5.1.2 The conservation objective for sea caves

Subject to natural change, maintain in favourable condition the **submerged or partially submerged sea caves**, in particular:

- The diversity of sea cave communities and their characteristic zonation.

5.1.3 The conservation objective for intertidal mud and sandflats

Subject to natural change, maintain in favourable condition the **mudflats and sandflats not covered by sea water at low tide**, in particular:

- The extent of eelgrass bed communities and mussel *Mytilus edulis* bed communities.
- The diversity of infaunal communities.

[5] A detailed definition of favourable condition is given in the glossary. For a detailed definition of how to recognise favourable condition see attached table (section 6).

5.1.4 The conservation objective for grey seals

Subject to natural change, maintain in favourable condition the habitats for **the grey seal *Halichoerus grypus***, in particular:

- The extent and suitability of grey seal *Halichoerus grypus* breeding habitat on the Farne Islands.

5.2 Lindisfarne SPA interest features

5.2.1 The conservation objective for the internationally important populations of regularly occurring Annex 1 species

Subject to natural change, maintain in favourable condition the habitats for **the internationally important populations of regularly occurring Annex 1 species**, in particular:

- Intertidal mudflat and sandflats
- Saltmarsh
- Eelgrass beds

5.2.2 The conservation objective for internationally important regularly occurring migratory species

Subject to natural change, maintain in favourable condition the habitats for the **internationally important populations of regularly occurring migratory species**, in particular:

- Eelgrass beds
- Intertidal mudflat and sandflats
- Saltmarsh

5.2.3 The conservation objective for the internationally important assemblage of waterfowl

Subject to natural change, maintain in favourable condition the habitats for the **internationally important assemblage of waterfowl**, in particular:

- Intertidal mudflat and sandflats
- Saltmarsh
- Eelgrass beds
- Rocky shores

Note: The SPA conservation objectives focus on habitat condition in recognition that bird populations may change as a reflection of national or international trends or events**.** Annual counts for qualifying species will be used by English Nature and Scottish Natural Heritage, in the context of five year peak means, together with available information on UK population and distribution trends, to assess whether this SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species across Europe.

Table 1 Information on the populations of internationally important species of birds under the EU Birds Directive using the Berwickshire and North Northumberland Coast European marine site at the time the SPA was classified.

Species	Qualifying status	Population as at October 1990*	% Population
Little tern= (*Sterna albifrons)*	Annex 1 (migratory breeding)	42 pairs	2 % (GB population)
Roseate tern= (*Sterna dougallii)*	Annex 1 (migratory breeding)	4 pairs	5 % (GB population)
Whooper swan (*Cygnus cygnus)*	Annex 1 (migratory wintering)	95 individuals	2 % (GB population)
Golden plover (*Pluvialis apricaria)*	Annex 1 (migratory wintering)	2,350 individuals	1 % (GB population)
Bar-tailed godwit (*Limosa lapponica)*	Migratory (wintering)	7,500 individuals 1985/86-1989/90	7 % (GB population)
Wigeon (*Anas penelope)*	Migratory (wintering)	16,400 individuals 1985/86-1989/90	2 % (population)
Greylag goose (*Anser anser)*	Migratory (wintering)	3,500 individuals 1985/86-1989/90	3 % (population)
Light-bellied brent goose (*Branta bernicla hrota)*	Migratory (wintering)	2,700 individuals 1985/86-1989/90	68 % (population)
Ringed plover (*Charadrius hiaticula)*	Migratory (wintering)	490 individuals 1985/86-1989/90	1 % (population)
Redshank (*Tringa totanus)*	Migratory (wintering)	3,600 individuals 1985/86-1989/90	3 % (population)

* SPA citation held on the Register of European Sites for GB.
= These species nest above the point of Highest Astronomical Tide.

6 Favourable condition table

The favourable condition table is supplied as part of English Nature's and Scottish Natural Heritage's Regulation 33 advice package in support of the conservation objectives for the Berwickshire and North Northumberland Coast European marine site (Section 5).

This table is intended to supplement the conservation objectives only in relation to management of established and ongoing activities and future reporting requirements on monitoring the condition of the site and its features. The table **does not by itself** provide a comprehensive basis on which to assess plans and/or projects as required under Regulations 20 and 48-50, but it does provide a basis to inform the scope and nature of any 'appropriate assessment' that may be needed. It should be noted that appropriate assessments are, by contrast, a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects. English Nature and Scottish Natural Heritage will provide more detailed advice to competent and relevant authorities in England and Scotland respectively, to assess the implications of any given plan or project under the Regulations, where appropriate, at the time a plan or project is being considered.

The favourable condition table is the principle source of information that English Nature will use to assess the condition of an interest feature and as such comprises indicators of condition. Scottish Natural Heritage are currently developing the details of their monitoring programme for Scotland and may issue supplementary advice in due course. On many terrestrial European sites, we know sufficient about the preferred or target condition of qualifying habitats to be able to define measures and associated targets for all attributes to be assessed in condition monitoring. Assessments as to whether individual interest features are in favourable condition will be made against these targets. In European marine sites we know far less about habitat condition and find it difficult to predict what favourable condition may look like. Individual sites within a single marine habitat category are also very different, further hampering the identification of generic indicators of condition. Accordingly, in the absence of such information, condition of interest features in European marine sites will be assessed against targets based on the existing conditions, which may need to be established through baseline surveys in many cases.

The assumption that interest features on European marine sites are in favourable condition will be tested in the 2000 - 2006 reporting period and the results subsequently fed back into this advice and site management. Where there is more than one year's observations on the condition of marine habitats, all available information will be used to set the site within long-term trends in order to form a view on favourable condition. Where it may become clear that certain attributes are a cause for concern, and if detailed studies prove this correct, restorative management measures will need to be taken to return the interest feature from unfavourable to favourable condition. It is the intention of English Nature to provide quantification of targets in the favourable condition table during the 2000 - 2006 reporting period.

This advice also provides the basis for discussions with management and advisory groups, and as such the attributes and associated measures and targets may be modified over time. The aim is to produce a single agreed set of attributes that will then be monitored in order to report on the condition of features. Monitoring of the attributes may be of fairly coarse methodology, underpinned by more rigorous methods on specific areas within the site. To meet UK agreed common standards, English Nature will be committed to reporting on each of the attributes subsequently listed in the final version of the table, although the information to be used may be collected by other organisations through agreements.

The table will be an important, but not the only, driver of the site monitoring programme. Other data, such as results from compliance monitoring and appropriate assessments, will also have an important role in assessing condition. The monitoring programme will be developed as part of the management scheme process through discussion with the relevant authorities and other interested parties. English Nature and Scottish Natural Heritage will be responsible for collating the information required to assess condition and will form a judgement on the condition of each feature within the site, taking into account all available information and using the favourable condition table as a guide.

Box 1	**Glossary of terms used in the favourable condition table**
Feature	The habitat or species for which the site has been selected**.**
Sub-feature	An ecologically important sub-division of the feature.
Attribute	Characteristic of an interest/sub-feature which provides an indication of the condition of the feature or sub-feature to which it applies.
Measure	What will be measured in terms of the units of measurement, arithmetic nature and frequency at which the measurement is taken. This measure will be attained using a range of methods from broad scale to more specific across the site.
Target	This defines the desired condition of an attribute, taking into account fluctuations due to natural change. Changes that are significantly different from the target will serve as a trigger mechanism through which some further investigation or remedial action is taken .
Comments	The rationale for selection of the attribute.

Table 2 Favourable condition table

NB - Many of the attributes will be able to be monitored at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Reefs		Extent	Area (ha) of the reefs, measured periodically (frequency to be determined)	No decrease in extent from an established baseline (Foster-Smith, 1998), subject to natural change.	Extent of reef is reporting requirement of the Habitats Directive. The extent of reef should not change significantly over time unless due to some human activity but needs to be measured periodically.
		Water density (salinity and temperature)	Average temperature and salinity measured periodically in the subtidal, throughout the reporting cycle.	Average density should not deviate significantly from an established baseline, subject to natural change.	Temperature and salinity are characteristic of the overall hydrography of the area. Temperature and salinity profiles can influence the presence and distribution of species (along with recruitment processes and spawning behaviour) including those at the edge of their geographic ranges and non-natives. This will also apply to the cave features.
		Water clarity	Average light attenuation measured periodically throughout the reporting cycle (frequency to be determined).	Average light attenuation should not deviate significantly from an established baseline, subject to natural change.	Water clarity is a key process influencing algal/plant growth, density and extent and hence, algal/plant dominated biotopes. Changes in water clarity may be caused by increases in suspended material due to a range of processes. (This will also apply to the cave features)
	Rocky shore communities	Distribution of rocky shore communities	Distribution of intertidal rocky shore biotopes (listed in Appendix 1) measured using littoral extent during the summer, once during reporting cycle.	Distribution of intertidal rocky shore biotopes should not deviate significantly from an established baseline (Brazier *et al*, 1999), subject to natural change.	The distribution of rocky shore biotopes is an important structural aspect of the site. Changes in extent and distribution may indicate long term changes in the physical conditions at the site.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Reefs	Kelp forest communities	Distribution of characteristic communities	Distribution of kelp dominated biotopes (in particular the biotopes listed in Appendix 1), measured once during reporting cycle.	Distribution of kelp dominated biotopes should not deviate significantly from an established baseline (Foster-Smith, 1998), subject to natural change.	The distribution of kelp biotopes is an important structural aspect of the feature. Changes in extent and distribution may indicate long term changes in the physical conditions at the site.
		Species composition of characteristic communities	Presence and abundance of composite species (in particular, red algal species, for example LhypR.Ft biotope), measured during summer, once during reporting cycle.	Presence and abundance of composite species should not deviate significantly from an established baseline (Brazier *et al*., 1999), subject to natural change.	Species composition is an important contributor to the structure of the kelp forests and therefore the reef as a whole. The presence and relative abundance of characterising species gives an indication of the quality of the kelp forests and change in composition may indicate cyclic change/trend in reef communities.
	Subtidal faunal turf communities	Distribution characteristic subtidal faunal turf communities	Distribution of circalittoral faunal turf communities (in particular the biotopes listed in Appendix 1), measured once during reporting cycle.	Distribution of circalittoral faunal turf communities should not deviate significantly from an established baseline (Foster-Smith, 1998; Brazier *et al*., 1999), subject to natural change.	The distribution of faunal turf biotopes is an important structural aspect of the site. Changes in extent and distribution may indicate long term changes in the physical conditions at the site.
		Extent of characteristic biotope (brittlestar beds).	Extent of brittlestar biotope (Oph), measured during summer, once during reporting cycle.	The extent of brittlestar biotope should not deviate significantly from an established baseline (Foster-Smith, 1998), subject to natural change.	Brittlestar beds are an important contributor to the structure of the circalittoral faunal turf biotope complex and therefore the reef as a whole. The location and extent of this biotope gives an indication of the quality of the reef system and change may indicate cyclic change/trend in reef communities.
Submerged or partially submerged sea caves	Intertidal sea cave communities	Range and distribution of characteristic intertidal sea cave communities	Range and distribution of intertidal sea cave biotopes (in particular the biotopes listed in Appendix 3), both within and through a range of sea caves, measured once during reporting cycle.	Range and distribution of intertidal cave biotopes should not deviate significantly from an established baseline (ERT, 1997; ERT, in prep.), subject to natural change.	The range and distribution of intertidal sea cave biotopes is an important structural aspect of the cave interest feature. Changes in the extent and distribution may indicate long term changes in the physical condition at the European marine site.
Submerged or	Subtidal sea	Range and distribution	Range and distribution of	Range and distribution of	The range and distribution of the subtidal sea cave

Feature	Sub-feature	Attribute	Measure	Target	Comments
partially submerged sea caves	cave communities	of characteristic subtidal sea cave communities	subtidal sea cave biotopes (in particular the biotopes listed in Appendix 3), both within and through a range of sea caves, measured once during reporting cycle.	subtidal sea cave biotopes should not deviate from an established baseline (ERT, 1997; ERT, in prep.), subject to natural change.	biotopes is an important structural aspect of the cave feature. Changes in the extent and distribution may indicate long term changes in the physical condition at the European marine site.
Mudflats and sandflats not covered by seawater at high tide		Extent	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline (Aerial photos 1991), subject to natural change.	Extent is an attribute on which reporting is required by the Habitats Directive. For dynamic coastlines fluctuations may be great, but are attributable to natural coastal processes. Extent is dictated by the physical conditions, especially the physiography and underlying geology coupled with the hydrodynamic regime.
		Sediment character	Sediment grain size. Particle size analysis. Parameters include % sand/silt/gravel, mean and median grain size and sorting co-efficient, used to characterise sediment type, measured periodically (frequency to be determined).	Average sediment parameters should not deviate significantly from an established baseline, subject to natural change.	Sediment character defined by particle size analysis is key to the structure of the feature, and reflects all of the physical processes acting on it. Particle size composition varies across the feature and can be used to indicate spatial distribution of sediment types thus reflecting the stability of the feature and the processes supporting it. The character of a sediment will influence the biological communities associated with it. The sediment character is particularly important for maintaining the condition of the eelgrass beds. If the sediment particle size increased the habitat would be unsuitable for eelgrass colonisation. There is concern that the causeway at Lindisfarne may be increasing the deposition of sandier particles in some places.
			Organic carbon. % organic carbon from sediment sample, measured periodically (frequency to be determined).	Average organic carbon content should not increase in relation to an established baseline, subject to natural change.	Organic content critically influences the infaunal community and can cause deoxygenation of the feature which can be detrimental to the biota.
Mudflats and sandflats not		Sediment character	Redox layer, measured periodically (frequency to	Average black layer depth/ Eh should not increase	Degree of oxidation/reduction, reflecting oxygen availability within the sediment, critically

Feature	Sub-feature	Attribute	Measure	Target	Comments
covered by seawater at high tide			be determined).	significantly from an established baseline, subject to natural change.	influences the infaunal community and the mobility of chemical compounds. It is an indicator of the structure of the feature.
		Extent of macroalgal mats (in particular *Entermorpha* spp.)	Abundance and distribution of *Entermorpha* spp. on the mudflats and sandflats measured during September, annually. At Lindisfarne, measured during the winter and summer.	No increase in the extent of macroalgal mats from an established baseline including Allen *et al* (1999), subject to natural change.	Ephemeral green macroalgae can indicate elevated nutrient levels. This may reduce the quality of the sediments and their communities, mainly through processes such as smothering and deoxygenation.
	Eelgrass bed communities	Extent of characteristic eelgrass communities	Abundance and distribution of characteristic eelgrass biotopes measured at Lindisfarne during August, annually.	Abundance and distribution of characteristic eelgrass biotopes should not deviate significantly from an established baseline (Allen *et al*, 1999), subject to natural change.	Eelgrass beds contribute to the overall community structure of the intertidal mudflats and sandflats at Lindisfarne. The extent of eelgrass provides a long-term integrated measure of the condition of this important sub-feature and of the intertidal sediment interest feature.
	Mussel *Mytilus edulis* bed communities	Extent of characteristic mussel bed communities	Abundance and distribution of characteristic mussel bed biotopes at Lindisfarne measured during August, annually.	Abundance and distribution of characteristic mussel bed biotopes should not deviate significantly from an established baseline (Allen *et al*, 1999), subject to natural change.	Mussel beds have established at Lindisfarne, providing and important anchorage for fucoid algae and other marine species, and help to stabilise the sediment. The mussels and other organisms they harbour provide and important food supply for marine predators such as crustaceans, echinoderms, fish and birds. The mussel beds at Lindisfarne are also currently under review for possible farming. The extent of the mussel bed communities will provide a long-term measure of the condition of this important sub-feature and of the intertidal mudflats and sandflats.
Mudflats and sandflats not covered by	Sand communities	Distribution of characteristic communities	Distribution of characteristic sand biotopes (in particular the	Distribution of characteristic sand biotopes should not deviate	The relative distribution of infaunal biotopes is an important structural aspect of the site. Changes in extent and distribution may indicate long term

Feature	Sub-feature	Attribute	Measure	Target	Comments
seawater at high tide			biotopes listed in Appendix 2), measured once during reporting cycle.	significantly from an established baseline including Allen *et al*. (1999), subject to natural change.	changes in the physical conditions at the site.
	Mud and muddy sand communities	Distribution of characteristic communities	Distribution of characteristic mud and muddy sand biotopes (in particular the biotopes listed in Appendix 2), measured once during reporting cycle.	Distribution of characteristic mud and muddy sand biotopes should not deviate significantly from an established baseline including Allen *et al*. (1999), subject to natural change.	The relative distribution of infaunal biotopes is an important structural aspect of the site. Changes in extent and distribution may indicate long term changes in the physical conditions at the site.
Grey seals		Disturbance	Reduction or displacement of grey seals measured using average count information measured periodically (frequency to be determined).	No significant reduction in numbers or displacement of grey seals from an established baseline, subject to natural change.	Excessive disturbance can cause stress and result in reduced food intake and/or increased energy expenditure. Disturbance in suitable breeding areas may result in a reduced pup production.
	Rocky and coarse sediment shores	Extent	Total area (ha), measured once during reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Suitable rocky and coarse sediment shores provide an important breeding and hauling out habitat for grey seals within the site. Important breeding and hauling out areas within the site are illustrated in Figure 4.
Internationally important Annex 1 Bird Populations		Disturbance	Reduction or displacement of birds using 5 year peak mean information on populations.	No significant reduction in numbers or displacement of birds from an established baseline, subject to natural change.	Excessive disturbance can cause stress and result in reduced food intake and/or increased energy expenditure.
		Absence of obstruction to viewlines	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing viewlines.	Whooper swans and golden plover require unrestricted views to allow early detection of predators when feeding and roosting. Whooper swan require views >500m. Golden plover require views >200m.

Feature	Sub-feature	Attribute	Measure	Target	Comments
	Intertidal mudflats and sandflats	Extent and distribution of habitat	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline (Aerial photos 1991), subject to natural change.	Intertidal mudflats and sandflats are important roosting areas for qualifying Annex 1 species such as golden plover. A measure of the extent of this habitat will help provide an assessment of the condition of suitable intertidal sediment roosting habitat.
	Saltmarsh	Extent and distribution of habitat	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline (Aerial photos 1991), subject to natural change.	Saltmarsh is an important feeding area for whooper swan.
		Presence and abundance of food species	Presence and abundance of saltmarsh communities, particularly soft leaved grasses and herbs such as *Salicornia* spp.	Presence and abundance of saltmarsh communities should not deviate significantly from an established baseline, subject to natural change.	Saltmarsh habitats provide important feeding areas, in particular for whooper swans.
	Eelgrass beds	Extent and distribution of habitat	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline (Aerial photos 1991), subject to natural change.	Eelgrass beds are an important feeding area for whooper swan.
		Presence and abundance of food species	Presence and abundance of eelgrass biotopes, measured periodically (frequency to be determined).	Presence and abundance of eelgrass biotopes should not deviate significantly from an established baseline (Allen *et al.* 1999), subject to natural change.	Eelgrass communities provide important feeding areas, in particular for whooper swans.
Internationally Important populations of migratory species		Disturbance in roosting and feeding areas	Reduction or displacement of birds using 5 year peak mean information on populations.	No significant reduction in numbers or displacement of birds from an established baseline, subject to natural change.	Excessive disturbance can cause stress and result in reduced food intake and/or increased energy expenditure.

Feature	Sub-feature	Attribute	Measure	Target	Comments
species		Absence of obstruction to viewlines	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing viewlines.	Geese and waders require unrestricted views to allow early detection of predators when feeding and roosting. Light –bellied brent geese require views >500m. Waders require views >200m.
	Eelgrass beds	Extent and distribution of habitat.	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline (Aerial photos 1991), subject to natural change.	An important feeding area for light bellied geese and wigeon.
		Presence and abundance of food species	Presence and abundance of eelgrass biotopes, measured periodically (frequency to be determined).	Presence and abundance of eelgrass biotopes should not deviate significantly from an established baseline (Allen *et al.* 1999), subject to natural change.	Eelgrass communities provide an important food source for light bellied geese and wigeon..
	Intertidal mudflats and sandflats	Extent	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline (Aerial photos 1991), subject to natural change.	Intertidal mudflats and sandflats are important roosting areas for qualifying migratory birds.
		Presence and abundance of food species	Presence and abundance of food species, measured periodically (frequency to be determined).	Presence and abundance of food species should not deviate significantly from an established baseline, subject to natural change.	Maintenance of food species, including bivalve molluscs and marine worms, is essential for many species including the ringed plover, bar-tailed godwit and redshank.
	Saltmarsh	Extent	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline, subject to natural change.	Saltmarsh areas provide important roosting areas for qualifying migratory birds.
		Presence and abundance of food species	Presence and abundance of saltmarsh communities, particularly soft leaved grasses and herbs such as *Salicornia* spp.	Presence and abundance of saltmarsh communities should not deviate significantly from an established baseline, subject to natural change.	Saltmarsh habitats provide important feeding areas for light bellied goose and wigeon.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally Important populations of migratory species		Vegetation characteristics	Open, short vegetation or bare ground predominating.	Vegetation height throughout areas used for roosting should not deviate significantly from an established baseline.	Vegetation of <10cm is required throughout areas for roosting by waders.
Internationally important assemblage of waterfowl		Absence of obstruction to viewlines	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing viewlines.	Geese and waders require unrestricted views to allow early detection of predators when feeding and roosting. Light –bellied brent geese require views >500m. Waders require views >200m.
		Disturbance in roosting and feeding areas	Reduction or displacement of birds using 5 year peak mean information on populations.	No significant reduction in numbers or displacement of birds from an established baseline, subject to natural change.	Excessive disturbance can cause stress and result in reduced food intake and/or increased energy expenditure.
	Rocky shores	Extent	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline, subject to natural change.	Rocky shores are important feeding areas for a range of bird species.
		Presence and abundance of food species	Presence and abundance of food species (particularly invertebrates), measured periodically (frequency to be determined).	Presence and abundance of food species should not deviate significantly from an established baseline, subject to natural change.	Rocky shores provide an important food supply including bivalve molluscs, crustaceans and worms, for a range of internationally important bird species.
	Eelgrass beds	Extent	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline, subject to natural change.	Eelgrass beds are important feeding areas for wildfowl.
		Presence and abundance of food species	Presence and abundance of eelgrass biotopes, measured periodically (frequency to be determined).	Presence and abundance of eelgrass biotopes should not deviate significantly from an established baseline (Allen *et al.* 1999), subject to natural change.	Eelgrass communities provide important feeding areas, in particular for whooper swans.

Feature	Sub-feature	Attribute	Measure	Target	Comments
	Saltmarsh	Extent	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline, subject to natural change.	Saltmarsh areas provide important roosting areas for qualifying birds.
		Presence and abundance of food species	Presence and abundance of saltmarsh communities, particularly soft leaved grasses and herbs such as *Salicornia* spp.	Presence and abundance of saltmarsh communities should not deviate significantly from an established baseline, subject to natural change.	Saltmarsh habitats provide important feeding areas for light bellied goose and wigeon.
		Vegetation characteristics	Open, short vegetation or bare ground predominating.	Vegetation height throughout areas used for roosting should not deviate significantly from an established baseline.	Vegetation of <10cm is required throughout areas for roosting by waders.
	Intertidal mudflats and sandflats	Extent	Total area (ha) measured periodically (frequency to be determined).	No decrease in extent from an established baseline (Aerial photos 1991), subject to natural change.	Intertidal mudflats and sandflats are important roosting areas for qualifying birds.
		Presence and abundance of food species	Presence and abundance of food species (particularly invertebrates), measured periodically (frequency to be determined).	Presence and abundance of food species should not deviate significantly from an established baseline, subject to natural change.	Intertidal sediments provide an important food supply, including bivalve molluscs, crustaceans and worms, for a range of internationally important bird species.

Note: Extreme events (such as storms reducing or increasing salinities, exceptionally cold winters or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Berwickshire and North Northumberland Coast European marine sites and may well be missed by routine monitoring.

7 Introduction to the advice on operations

This section includes information in support of the advice required under Regulation 33(2)(b).

English Nature and Scottish Natural Heritage have a duty under Regulation 33(2)(b) of the Conservation (Natural Habitats &c.) Regulations 1994 to advise other relevant authorities as to any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated. Information on how this advice has been developed is given in Section 7.2, and on how it may be reviewed and updated in the future, in Section 7.4.

7.1 Purpose of advice

The aim of this advice is to enable relevant authorities to direct and prioritise their work on the management of activities that pose the greatest potential threats to the favourable condition of interest features on the Berwickshire and North Northumberland Coast European marine site. The advice is linked to the conservation objectives for interest features and once issued, will help provide the basis for detailed discussions within the management group to formulate and agree a management scheme to agreed timescales for the site. The advice given here will inform on, but is without prejudice to, any advice to be given subsequently under Regulation 48 or Regulation 50 on operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

7.2 Methods for assessment

To develop this advice on operations a three-step process has been used involving:

- an assessment of **sensitivity** of the interest features or their component sub-features to operations;
- an assessment of the **exposure** of each interest feature or their component sub-features to operations; and
- a final assessment of **current vulnerability** of interest features or their component sub-features to operations.

This three-step process builds up a level of information necessary to manage activities in and around the European marine site in an effective manner. Through a consistent approach, this process enables an explanation of the reasoning behind the advice and identifies to competent and relevant authorities those operations which pose the most current threats to the favourable condition of the interest features on the European marine site.

All the scores of sensitivity, exposure and vulnerability are derived using best available scientific information and informed scientific interpretation and judgement. The process uses sufficiently coarse categorisation to minimise uncertainty in information, reflecting the current state of our knowledge and understanding of the marine environment. Information has been gathered from a range of sources including reports such as ABP Research & Consultancy (1999).

7.2.1 Sensitivity assessment

The assessment used is of relative sensitivity of the interest features or the component sub-features of the Berwickshire and North Northumberland Coast European marine site to the effects of broad categories of human activities. In relation to this assessment, sensitivity has been defined as the intolerance of a habitat, community or individual (or individual colony) of a species to damage, or death, from an external factor (Hiscock, 1996). For example, kelp forest communities are sensitive to physical damage by abrasion.

The sensitivity assessments of the interest features or their component sub-features of the Berwickshire and North Northumberland Coast European marine site are based upon a series of scientific review documents. These include reports produced for the UK Marine SAC *LIFE* project such as Elliott *et al.* (1998).

The sensitivity assessments are based on current information but may develop with improvements in scientific knowledge and understanding. In particular, English Nature and Scottish Natural Heritage have commissioned the Marine Biological Association of the UK, through its Marine Life Information Network (MarLIN) to provide detailed sensitivity information to underpin this advice, over the next three years and available to all on the World Wide Web (www.marlin.ac.uk).

7.2.2 Exposure assessment

This has been undertaken for the Berwickshire and North Northumberland Coast European marine site by assessing the relative exposure of the interest or their component sub-features on the site (as at November 1999) to the effects of human activities to which they are sensitive. For example, some stretches of the site have a high exposure to nutrient enrichment from diffuse land run off. This is a preliminary assessment of current levels of exposure. A more detailed understanding will come from investigations such as the Environment Agency review of consents.

7.2.3 Vulnerability assessment

The third step in the process is to determine the vulnerability of interest features or their component sub-features to operations. This is an integration of sensitivity and exposure. Only if a feature is both sensitive and exposed to a human activity will it be considered vulnerable. In this context therefore, 'vulnerability' has been defined as the exposure of a habitat, community or individual (or individual colony) of a species to an external factor to which it is sensitive (Hiscock, 1996). For example, reef communities are sensitive to contamination by radionuclides, but they are not currently exposed to any such contamination and therefore are not vulnerable. The process of deriving and scoring vulnerability is provided in Appendix 4.

7.3 Format of advice

The advice is provided within six broad categories of operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species. This approach therefore:

- enables links to be made between human activities and the ecological requirements of the habitats or species, as required under Article 6 of the Habitats Directive;

- provides a consistent framework to enable relevant authorities in England and Scotland to assess the effects of activities and identify priorities for management within their areas of responsibility; and

- is appropriately robust to take into account the development of novel activities or operations which may cause deterioration or disturbance to the interest features of the site and should have sufficient stability to need only infrequent review and updating by English Nature and Scottish Natural Heritage.

These broad categories and site specific examples of operations provide a clear framework against which relevant authorities can assess activities under their responsibility. The more detailed information in Table 4 provides relevant authorities with a context against which to consider an assessment of 'significant effect' for any plans or projects which may affect the site and a basis to inform on the scope and nature of appropriate assessments required in relation to plans and projects. It is important to note that this advice is only a starting point for assessing impacts. It does not remove the need for the relevant authorities to formally consult English Nature or Scottish Natural Heritage over individual plans and projects where required to do so under the Regulations.

7.4 Update and review of advice

Information as to the operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated, is provided in light of what English Nature and Scottish Natural Heritage know about current activities and patterns of usage at the Berwickshire and North Northumberland Coast European marine site. It is expected that the information on current activities and patterns of usage will be refined as part of the process of developing the management scheme through further discussion with the relevant authorities. The option of zoning this information may be appropriate. As such, it is important that future consideration of this advice by relevant authorities and others takes account of changes in the usage patterns that have occurred at the site, over the intervening period, since the advice was issued. In contrast, the information provided in this advice on the sensitivity of interest features or sub-features is relatively stable and will only change as a result of an improvement in our scientific knowledge, which will be a relatively long term process. Advice for sites will be kept under review and may be periodically updated through discussions with relevant authorities and others to reflect significant changes in our understanding of sensitivity together with the potential effects of plans and projects on the marine environment.

8 Advice on operations

This section is provided in compliance with Regulation 33(2)(b) of the Conservation (Natural Habitats &c.) Regulations 1994.

8.1 Summary of advice on operations

8.1.1 Reefs

In pursuit of the conservation objective for reefs (section 5.1.1), the relevant and competent authorities for the Berwickshire and North Northumberland Coast European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, as a result of any of the following:

- Physical loss through removal or smothering.
- Physical damage through siltation and/or abrasion.
- Synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment and/or changes in turbidity.
- Biological disturbance through the selective extraction of species.

8.1.2 Intertidal mudflats and sandflats

In pursuit of the conservation objective for intertidal sand and mudflats (section 5.1.3), the relevant and competent authorities are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, as a result of any of the following:

- Physical loss through removal or smothering.
- Physical damage through siltation and/or abrasion and/or selective extraction.
- Synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment and/or changes in turbidity.
- Biological disturbance through the selective extraction of species.

8.1.3 Sea caves

In pursuit of the conservation objective for sea caves (section 5.1.2), the relevant and competent authorities are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, as a result of any of the following:

- Physical loss through removal.
- Physical damage through siltation and/or abrasion.
- Synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment and/or changes in turbidity.
- Biological disturbance through the selective extraction of species.

8.1.4 Grey seals

In pursuit of the conservation objective for grey seals (section 5.1.4), the relevant and competent authorities are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, as a result of any of the following:

- Visual disturbance and/or disturbance by noise.
- Synthetic toxic contamination.

8.1.5 Lindisfarne SPA Annex 1 species

In pursuit of the conservation objective for habitats that support internationally important populations of the regularly occurring Annex 1 species (section 5.2.1), the relevant and competent authorities are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, as a result of any of the following:

- Physical loss through removal and/or smothering.
- Physical damage through abrasion and/or selective extraction.
- Visual disturbance and/or disturbance by noise.
- Synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment and/or changes in turbidity.
- Biological disturbance through the selective extraction of species.

8.1.6 Lindisfarne SPA internationally important migratory species

In pursuit of the conservation objective for habitats that support internationally important populations of regularly occurring migratory species (section 5.2.2), the relevant and competent authorities are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, as a result of any of the following:

- Physical loss through removal and/or smothering.
- Physical damage through abrasion and/or selective extraction.
- Visual disturbance and/or disturbance by noise.
- Synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment and/or changes in turbidity.
- Biological disturbance through the selective extraction of species.

8.1.7 Lindisfarne SPA internationally important assemblage of waterfowl

In pursuit of the conservation objective for habitats that support the internationally important assemblage of waterfowl (section 5.2.3), the relevant and competent authorities are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, as a result of any of the following:

- Physical loss through removal or smothering.
- Physical damage through abrasion and/or selective extraction.
- Visual disturbance and/or disturbance by noise.
- Synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment and/or changes in turbidity.
- Biological disturbance through the selective extraction of species.

Table 3. Showing operations which may cause deterioration or disturbance to the Berwickshire North Northumberland Coast European marine site interest features at current levels of use[5]

The vulnerability ratings identified in this table relate the interest features to the categories of operations which may cause deterioration or disturbance. For example, reefs, are considered to be vulnerable to physical loss through removal. The ticks given do not specifically relate to the individual examples of current operations identified

The advice below is not a list of prohibitions but rather a checklist of operations for discussion with the management group, which may need to be subject to some form of management measure(s) or further measures where actions are already in force. Examples of activities under relevant authority jurisdiction are also provided. Operations marked with a [indicate those features (or some component of them) that are considered to be highly or moderately vulnerable to the effects of the operations.

English Nature's and Scottish Natural Heritage's advice under Regulation 33(2), operations which may cause deterioration or disturbance		SAC interest features				Lindisfarne SPA interest features		
Categories of operations	**Examples of current operations**	**Reefs**	**Intertidal mudflats and sandflats**	**Sea caves**	**Grey Seals**	**Annex 1 species**	**Migratory waterfowl**	**20,000+ assemblage**
Physical loss								
Removal	Coastal development Coastal defence Dredging for shellfish Maintenance dredging Trawling (benthic and demersal fisheries)	[	[	[		[	[	[
Smothering	Coastal development Coastal defence Dredging for shellfish Maintenance dredging Trawling (benthic and demersal fisheries) Disposal of dredged material	[	[			[	[	[
Physical damage								
Siltation	Coastal development Coastal defence Dredging for shellfish Maintenance dredging	[	[	[				
Abrasion	Anchoring Bait collection Coastal development Coastal defence Dredging for shellfish Land based recreation	[	[	[		[	[	[

English Nature's and Scottish Natural Heritage's advice under Regulation 33(2), operations which may cause deterioration or disturbance		SAC interest features				Lindisfarne SPA interest features		
Categories of operations	**Examples of current operations**	**Reefs**	**Intertidal mudflats and sandflats**	**Sea caves**	**Grey Seals**	**Annex 1 species**	**Migratory waterfowl**	**20,000+ assemblage**
Selective extraction	Bait collection Shellfishing by hand		[			[	[	[
Non-physical disturbance Noise	Recreational activities (e.g. watersports) Wildfowling				[	[	[	[
Visual	Bait collection Recreational activities (e.g. birdwatching, walking and watersports) Wildfowling				[	[	[	[
Toxic contamination Introduction of synthetic compounds	Effluent and sewerage discharge Oil and chemical spillage or discharge	[	[	[	[	[	[	[
Introduction of non-synthetic compounds	Oil and chemical spillage or discharge	[	[	[		[	[	[
Introduction of radionuclides	-							
Non-toxic contamination Nutrient enrichment	Agricultural effluents and runoff Aquaculture Effluent and sewage discharge	[	[	[		[	[	[
Organic enrichment	Agricultural effluents and run-off Aquaculture Effluent and sewage discharge	[	[	[		[	[	[
Change in thermal regime	-							
Changes in turbidity	Coastal development Coastal defence Dredging for shellfish Maintenance dredging	[	[			[	[	[
Changes in salinity	-							

English Nature's and Scottish Natural Heritage's advice under Regulation 33(2), operations which may cause deterioration or disturbance		SAC interest features				Lindisfarne SPA interest features		
Categories of operations	**Examples of current operations**	**Reefs**	**Intertidal mudflats and sandflats**	**Sea caves**	**Grey Seals**	**Annex 1 species**	**Migratory waterfowl**	**20,000+ assemblage**
Biological disturbance								
Introduction of microbial pathogens	Sewage discharge							
Introduction of non-native species	Aquaculture (oyster and mussel)							
Selective extraction of species	Bait collection (e.g. rag worm and lug worm) Commercial fisheries (eg potting) Diving Shellfishing by hand Wildfowling Culling of seals	[	[	[		[	[	[

[5] This advice has been developed using best available scientific information and informed scientific interpretation and judgement (as at November 1999). This process has used a coarse grading of relative sensitivity, exposure and vulnerability of each interest feature to different categories of operation based on the current state of our knowledge and understanding of the marine environment. This is shown in the sensitivity and vulnerability matrices in Table 4. The advice is indicative only, and is given to guide relevant authorities and others on particular operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the site has been designated**.** The advice, therefore, is not a list of prohibitions but rather a check list for operations which may need to be subject to some form of management measure(s) or further measures where actions are already in force.

The precise impact of any category of operation occurring on the site will be dependent upon the nature, scale, location and timing of events. More detailed advice is available from English Nature and Scottish Natural Heritage to assist relevant authorities in assessing actual impacts and cumulative effects. Assessment of this information should be undertaken in the development of the management scheme by the management group and through wider consultation.

In accordance with Government policy guidance, the advice on operations is feature and site specific, and provided in the light of current activities and patterns of usage at the site as at November 1999. As such, it is important that future consideration of this advice by relevant authorities, and others, takes account of changes in usage patterns that have occurred at the site over the intervening period. Advice for sites will be kept under review and may be periodically updated through discussions with relevant authorities, and others, to reflect significant changes in our understanding of sensitivity together with the potential effects of plans or projects on the marine environment. The provision of the statutory advice given here, on operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated, under Regulation 33(2), is provided without prejudice to specific advice given under Regulation 48 (3) or Regulation 50 on individual operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

8.2 Interest feature and sub-feature specific advice on operations

This section includes information in support of the advice required under Regulation 33(2)(b).

This section explains the relationship of the vulnerability of the interest features and sub-features of the Berwickshire and North Northumberland Coast European marine site to current levels of human usage as summarised in Table 3 and detailed in Table 4. Explanation of the sensitivity of the interest features or sub-features follows with an explanation of their exposure and therefore their vulnerability to damage or disturbance from the listed categories of operations. This enables links to be made between the categories of operation and the ecological requirements of the European marine site's interest features, as set out in Section 3.

8.2.1 Reefs

i) Physical loss

- The reefs of the Berwickshire and North Northumberland Coast are characterised by its size, naturalness, extent and the diversity of the communities and species. The loss of this reef habitat, or parts of it, could jeopardise the survival of some of those interest features or species and would therefore be detrimental to the favourable condition of the reef.

- All the sub-features of the reef are sensitive to removal and to smothering. This is because the loss of reef communities may affect the composition and distribution of other communities or species, many of which are inter-dependent upon the ecological functioning of others, with complex predator prey relationships established. The loss of one or more community may have major implications on the structure and functioning of others.

- Kelp forest, subtidal faunal turf and rocky shore communities are highly sensitive to physical loss by removal and moderately sensitive to smothering. As these sub-features are currently moderately exposed to activities which may result in physical loss, such as coastal development and dredging activities, reef sub-features are considered to be highly vulnerable to removal and moderately vulnerable to smothering.

ii) Physical damage

- Reef communities are sensitive to physical damage (Hill *et al*., 1998). Siltation can clog or block the feeding/respiratory organs of animals, which can lead to the death of individual organisms and potentially damaging the community. Abrasion can result in the dislodgement of individual organisms or groups of organisms and this too may impair the reef community. Damage caused by selective extraction can occur when particular elements of the habitat are physically removed which also has the potential to alter the condition of the reef.

- Kelp forest and subtidal faunal turf communities are currently considered to be highly vulnerable to physical damage by siltation and abrasion due to their moderate exposure to activities such as dredging, coastal defence and anchoring which may result in these processes on this site. Kelp forest communities are dependent on a certain level of water clarity for photosynthesis, so increased siltation may have a detrimental effect on their physiological functioning. Deposition of silt can also cover available hard substrata which interferes with the process of spore attachment (Jones *et al*., 1998). Young sporelings, or holdfasts which contain a diverse range of micro-niches for colonisation, are also sensitive to being covered by silt, which can inhibit their growth and development. Extensive physical damage may ultimately lead to loss of habitat.

- Most intertidal communities tend to be more resilient to physical damage than subtidal communities because of their adaptation to the natural physical processes to which they are subjected. These harsh conditions generally result in a rapid recolonisation and re-growth of communities. Rocky shores are

however, considered to be vulnerable to abrasion due to the current exposure to the effects of activities such as recreation, which may result in abrasion of newly settled spores at certain times of the year. If such damage is persistent, particularly on highly accessible shores, it may result in damage to fucoid communities and replacement by limpet/barnacles mosaics, thus altering the natural cycle of rocky shore ecology.

iii) Toxic contamination

- All reef sub-features are highly sensitive to the introduction of synthetic compounds such as polychlorinatedbiphenyls (PCBs) and tributyltin (TBT), and to the introduction of non-synthetic compounds which include oil and heavy metals, such as cadmium, lead and mercury. Many are known to have toxic effects even at low concentrations, with the larval stages of marine species being particularly sensitive, and many species known to bioaccumulate compounds (Hartnoll 1998). Many synthetic compounds pose a particular risk as they may not biodegrade within the marine environment (WRc, 1999). The sensitivity of reef communities to toxic contamination also reflects the number marine species which rely of larval dispersal for recruitment and filter the water for food.

- The vulnerability indices provided reflect the current exposure and sensitivity to toxic contaminants in areas within the site where they are subject to activities such as effluent and sewage discharge and oil or chemical discharge. Many of these activities are potential sources of toxic contaminant input and may be the result of both diffuse and point sources of pollution.

- Disturbance to the species composition of reef communities as a result of the effects of toxic contamination may result in changes to population structure, through the loss of key grazers or predators such as limpets or dogwhelks. In some species bioaccumulated toxins can be passed up the food chain (e.g. plaice feeding on mussels). This may affect the structure and function of the reef system.

iv) Non toxic contamination

- Reef communities are moderately sensitive to nutrient and organic enrichment as this may lead to a dominance by certain species such as the ephemeral green algae *Enteromorpha* spp. This in turn may change the structural composition of the reef community and potentially lead to a reduction in species diversity and biotopes, characteristic of the rocky shores. Ephemeral algal blooms, may also lead to eutrophic conditions, particularly in the upper shore areas, where algal mats can decompose and cause localised anoxic conditions.

- Reef communities are currently considered to be moderately vulnerable to nutrient and organic enrichment in areas where they are exposed to wastewater outfall pipes and agricultural run-off. In many cases however, nutrient enrichment from agricultural effluents and run-off is diffuse and the source difficult to locate.

- Increased water turbidity influences the ability of kelp and other algal species to photosynthesise. Therefore, activities which may result in a reduction in water clarity may affect the growth and survival of kelp forest, an important primary producer and reef habitat. Kelp forest communities are considered to be vulnerable in areas where they are exposed to activities such as dredging operations.

v) Biological disturbance

- All of the reef sub-features are considered moderately sensitive to selective extraction of species. Removal of particular species from the feature may disrupt the stability of reef communities and species which depend upon their stability. This is because the removal of particular species or predators from a marine food web, or trophic level, may not only affect the population of that species but can also have knock-on effects for inter-related species. The potential impacts of selectively extracting a particular species is complex and little understood at present.

- Kelp forest and subtidal faunal turf communities are currently considered to be highly vulnerable to selective extraction of species. Rocky shore communities are currently moderately vulnerable to this process. The selective extraction of lobsters and crabs by creeling for example, from kelp forests and associated reef habitats may have important ecological consequences. These communities are considered to be important habitats for a diverse assemblage of species and the impacts of selective extraction on this habitat presently is unclear. Similarly, removal of marine plants and animals in the intertidal area may affect the ecology of the habitat.

8.2.2 Mud and sandflats not covered by seawater at low tide

i) Physical loss

- All the sub-features of the intertidal mudflats and sandflats are highly sensitive to physical loss through removal and moderately sensitive to smothering. Loss of the feature or parts of it could damage its long-term condition. Many intertidal sediments provide natural sea defences and have an important structural as well as functional role in the ecology of the Berwickshire and North Northumberland Coast.

- Activities that may influence the hydrodynamic regime, such as coastal defence and coastal development, can lead to changes to sediment deposition rates which may subsequently result in smothering. Although sediment communities depend on a suitable supply of sediment, the species composition of communities can be altered if the sediment supply becomes excessive and leads to smothering.

- Currently, intertidal mudflats and sandflats are exposed to the effects of activities which may result in physical loss of this feature or part of it. Hence, all the sub-features of this feature are currently considered vulnerable to removal and smothering.

ii) Physical damage

- Activities that result in abrasion, such as use of four wheel drive vehicles and digging for bait, may cause the destabilisation of the sediment and an increase in its erosion. This can alter the structure and function (both physically and biologically) of the sub-features of the intertidal flats and ultimately could lead to loss of the interest feature. Infaunal communities are currently considered moderately vulnerable to selective extraction, due to their sensitivity and current exposure to activities such as bait digging.

- Most sediment communities are relatively tolerant of the naturally turbid or silty conditions. However, changes in the grain size of intertidal and subtidal sediments, caused by an increased input of fine material, can alter their community composition. Eelgrass communities are moderately vulnerable to siltation caused by operations such as coastal development and dredging activities. Modification of the natural sedimentation patterns caused by any operation that may change the hydrodynamic regime may impact upon the condition of the intertidal areas.

iii) Toxic contamination

- All the sub-features of intertidal mudflats and sandflats are considered highly sensitive to the introduction of synthetic compounds and moderately sensitive to the introduction of non-synthetic compounds. Such compounds can have both lethal and sub-lethal toxic effects on marine species, altering their species diversity and composition within the sediment. Larval and juvenile stages of invertebrates are in many cases more sensitive than the adults. Sub-lethal effects are more difficult to observe and measure but often can be as detrimental as lethal effects, potentially disrupting an organism's physiology, reproductive efficiency and /or competitive ability for survival.

- Due to a moderate exposure to low levels of toxic contamination caused by activities such as effluent and sewage discharge, intertidal mudflat and sandflat communities are considered to be moderately vulnerable to non-synthetic contaminants and highly vulnerable to synthetic contaminants. Toxic compounds can be passed through the food chain (bioaccumulation) and may impact upon predator species such as birds and fish. Heavy metals that have accumulated in the sediment can be re-mobilised by activities that alter the integrity of the mud flat such as bait digging or dredging.

iv) Non-toxic contamination

- Intertidal mudflat and sandflat communities are sensitive to nutrient and organic enrichment. Such inputs can locally lower oxygen levels, making the flats anoxic. Many infaunal communities require a good supply of oxygen whilst some infaunal species are more tolerant of eutrophication and organic enrichment and thrive in such conditions. The consequence of contamination can be an alteration in community composition.

- Eutrophication caused by a nutrient increase can also result in increased coverage of ephemeral algae and algal mats such as *Entermorpha* spp. Algal mats may be responsible for suppressing the aeration of burrowing worm and bivalve tunnels and as a consequence, species requiring a good supply of oxygen may be disadvantaged and the community structure may altered. Eelgrass communities are highly vulnerable to nutrient enrichment in areas where algal mats cover them. Mudflat and sandflat communities are moderately vulnerable to organic and nutrient enrichment due to a combination of their high sensitivity and the potential effects of activities such as agricultural effluents and run-off occurring in areas near to this sub-feature.

- Importantly, intertidal sediments can act as sinks for nutrients, metals and radionuclides. If disturbed, these can be released into the water column and become available for uptake by animals and plants. This may be an area of concern where activities occur which disturb the sediment.

- Eelgrass bed communities are highly sensitive to changes in turbidity. This can reduce the degree of light penetration in the water column and as a consequence, affect the plants' ability to photosynthesise. Current levels of exposure to activities which may increase the turbidity in eelgrass bed areas suggest a moderate vulnerability to this process.

v) Biological disturbance

- The selective extraction of part of an interest feature such as the removal of worms for bait from intertidal mudflats and sandflats may alter its biological composition and ecology. This may also have implications on the food supply of birds and marine predators. Characteristic species of the interest feature such as lug worm and rag worm play an important and complex role in the functioning of the ecology of the intertidal flats.

8.2.3 Sea caves

i) Physical loss

- The large number and extent of intertidal and subtidal sea caves on the Berwickshire and North Northumberland Coast are of international marine nature conservation importance because they support a range of habitats and associated fauna and flora. The loss of the sea caves feature or any part of it, may affect the survival of some of these habitats or species and may be detrimental to the favourable condition of the sea caves. Intertidal and subtidal sea caves are considered to be sensitive to physical loss caused by removal or smothering because such losses would be permanent.

- Sea cave communities are dependant upon each other for their ecological functioning and the loss of one community may have implications on the condition of others. This linkage should not therefore be overlooked when the potential impact of removal is considered. Currently, sea cave communities are considered vulnerable to physical loss that may arise from activities such as coastal development. Deterioration or disturbance by physical removal can be the result of either one-off events or chronic activities.

ii) Physical damage

- Physical damage resulting from abrasion may cause the dislodgement of species or damage to the structure of habitats or species in sea cave communities. Intertidal and subtidal caves are sensitive to abrasion as a result of persistent recreational activity such as trampling and diving respectively. Intertidal caves are currently vulnerable to abrasion caused by recreational activities.

- Activities which influence the hydro-physical regime such as coastal development and coastal defence, may have a detrimental effect on the sea cave communities due to increased siltation or abrasion. Changes in the patterns of water movement may also influence the transport of larvae and food to both intertidal and subtidal communities.

iii) Toxic contamination

- Sea cave communities, including microalgal, lichen and faunal turfs, are sensitive to toxic contaminants which may affect the species or communities similarly to those found on reefs. Sea caves located near activities such as industrial effluent, sewage, oil and chemical discharge are considered moderately vulnerable to the introduction of non-synthetics and highly vulnerable to the introduction of synthetic compounds.

iv) Non toxic contamination

- Intertidal sea cave communities are moderately sensitive to nutrient and organic enrichment. Increases in nutrients and organics may locally alter the physiochemical environment and may lead to a change in the structural composition of sea cave communities. Sea cave communities are considered vulnerable to a diffuse source of nutrient and organic enrichment due to their sensitivity and exposure to activities such as agricultural run-off.

v) Biological disturbance

- Certain subtidal cave species in popular diving areas may be exposed to selective extraction by divers. This may have ecological consequences for the biological communities.

8.2.4 Grey seals

i) Physical loss

- The maintenance of favourable condition of grey seals necessitates accessible and suitable rocky and coarse sediment shores, particularly at the Farnes. Such habitats are highly sensitive to physical loss. However, at current levels of use these grey seal habitats are not currently considered vulnerable.

ii) Non-physical disturbance

- Grey seals are highly sensitive to both visual and noise disturbance, which can have the effect of displacing them from their hauled out areas or breeding grounds. Seals affected by such disturbance may move to an alternative and perhaps less favourable site, or increase their energy intake through stress. Pup production may also be affected. However, breeding and pupping occurs at the time of year when the adverse weather conditions discourages activities that cause disturbance.

- The females are very susceptible to disturbance during pupping particularly from human activity. The main concentrations of breeding seals are on the outer Farne Islands, particularly North and South Wamses and Northern Hares. The proximity of these important habitats to activities such as coastal or water based recreation, together with their high sensitivity, means they are currently considered to be highly vulnerable to non-physical disturbance. The pupping season is from September to December and overlaps with the end of the watersports season which has usually ended by the end of October.

- Grey seals spend a large proportion of their time in the water within the site. Regard should therefore be given to the sensitivity of grey seals whilst they are in the water and the potential disturbance from noise and visual activities.

iii) Toxic contamination

- Grey seals are sensitive to both synthetic and non synthetic contamination, however they are considered highly sensitive to synthetic compounds. Such contaminants are thought to bioaccumulate in marine mammals with known sub-lethal toxicological effects. Certain synthetic compounds are also believed to be endocrine disruptors, posing a potential hazard for the local populations of grey seals or their prey species (WRc, 1999). At current levels of exposure, grey seals are considered to be moderately vulnerable to toxic contamination by synthetic compounds.

- Grey seals can be exposed to toxic substances through a variety of routes including uptake through the skin, ingestion of water and food. The primary exposure route is likely to be via food. Consequently, the toxic substances posing the greatest hazard to grey seals are likely to be those that have a detrimental effect on their main prey species which are fish. Toxic substances can accumulate in fish or cause sub-lethal responses such as disrupting endocrine functions (Cole *et al*, 1999) which may have an indirect adverse affect on the grey seals. Regard should therefore be given to the sensitivity of grey seals to toxic contamination whilst they are in the water and the potential sources and effects of such contaminants.

iv) Introduction of microbial pathogens

- Grey seals are moderately sensitive to certain microbial pathogens, particularly the phocine distemper virus. Regard should therefore be given to the potential sources and effects of such pathogens on grey seals within the European marine site.

8.2.5 Lindisfarne Special Protection Area interests

i) Physical loss

- The intertidal mudflat and sandflat, eelgrass, rocky shore and saltmarsh communities at Lindisfarne are important feeding and roosting habitats for internationally important populations of birds. These bird populations are highly sensitive to any loss of habitat and are considered moderately vulnerable to the effects of activities which may result in removal, such as coastal development. Eelgrass communities are moderately vulnerable to smothering as a consequence of their moderate sensitivity and current exposure.

ii) Physical damage

- Intertidal habitats at Lindisfarne are sensitive to those types of physical damage which reduce the food availability to the birds, or change the suitability of habitats for roosting or feeding. For example, certain birds depend on particular species for food and the selective extraction of such species may be detrimental to the favourable condition of those birds.

- The intertidal mudflat and sandflat, eelgrass, rocky shore and saltmarsh habitats are moderately vulnerable to physical damage from abrasion due to their sensitivity and current exposure to the potential effects of activities such as persistent land based recreation, bait collection and shell fishing by hand.

iii) Non-physical disturbance

- Waterfowl are highly sensitive to both visual and noise disturbance, which can cause them to be displaced from their roosting, feeding or breeding grounds. Disturbance can be caused by activities such as wildfowling and land and water based recreational activity. Birds may move to an alternative and perhaps less favourable site, or increase their energy expenditure through escape responses. This disruption in their behaviour may affect their survival. Over wintering waterfowl which migrate over large distances have particular energy budget requirements.

iv) Toxic contamination

- There is evidence to suggest that toxic compounds such as heavy metals and organophosphates can bioaccumulate in birds (WRc, 1999) which may have a detrimental affect on their physiology. The effects of such toxic compounds are variable, but may cause sub-lethal consequences and in extreme cases, may lead to mortality of individual birds. Potential sources of toxic contaminants include diffuse and off-site inputs (e.g. organophosphate sheep dips) as well as point sources such as effluent discharges. Given the potentially high vulnerability of birds to the effects of toxic compounds and the lack of information on the effects of such substances on the interest features of the site, there is a need for further investigative monitoring.

v) Non-toxic contamination

- The intertidal mudflat and sandflat, eelgrass, rocky shore and saltmarsh habitats are sensitive to nutrient and organic enrichment. This can affect birds particularly by reducing the availability of their food source by, for example, increasing growth of algal mats (*Entermorpha* spp.) on the intertidal flats, or by causing a change to the community structure through the domination of opportunist species. However, this may benefit some species that feed on green algae.

- Nutrient and organic enrichment can change the community structure of invertebrates on which the bird populations feed. This may have a detrimental affect on the ecological function of these prey species to their predators. Similarly, contamination by substances such as oil can reduce the quality of a habitat for feeding or roosting. The intertidal mudflat and sandflat communities are considered to be moderately vulnerable to nutrient and organic enrichment due to their sensitivity and exposure to current activities such as agricultural effluent and runoff. Organic enrichment can lead to an increase in biomass of specific sediment organisms such as *Nereis diversicolor*, this will influence the community structure of the predator populations.

vi) Biological disturbance

- The intertidal mudflat and sandflat and rocky shore habitats are moderately sensitive to selective extraction. Communities associated with these habitats are vulnerable to selective extraction which may arise as a result of activities such as bait digging or shell fishing by hand. Selective extraction of certain species from a habitat, species which may be necessary to support birds, can affect their condition in the long term. The ability of that habitat to continue to support those birds may therefore be reduced. An example of selective extraction that may have an effect on bird populations is the removal of rag worms and lug worm for fishing bait and wildfowling. Removal of key species may reduce food availability for particular foraging birds.

Table 4 Assessment of the relative vulnerability of interest features and sub-features of the Berwickshire and North Northumberland Coast European marine site to different categories of operation. Categories of operations to which the features or sub-features of the site are highly or moderately vulnerable are indicated by shading. The table also incorporates relative sensitivity scores used in part to derive vulnerability.[6]

Relative vulnerability of the feature or sub-feature

High Vulnerability

Moderate vulnerability

Relative sensitivity of the feature or sub-feature

●●●● **High sensitivity**
●●● Moderate sensitivity
●● Low sensitivity
● No detectable sensitivity

English Nature's and Scottish Natural Heritage's advice under Regulation 33(2), operations which may cause deterioration or disturbance		**SAC interest features**								
		Reefs			**Intertidal mudflats and sandflats**			**Sea caves**		**Grey seals**
Categories of operations	**Examples of current operations***	Rocky shore communities	Kelp forest communities	Subtidal faunal turf	Eelgrass bed communities	Mussel bed communities	Infaunal communities	Subtidal cave communities	Intertidal cave communities	Rocky and coarse sediment shores
Physical loss										
Removal	Coastal development Coastal defence Dredging for shellfish Maintenance dredging Trawling (benthic and demersal fisheries)	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Smothering	Coastal development Coastal defence Dredging for shellfish Maintenance dredging Trawling (benthic and demersal fisheries) Disposal of dredged material	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●

* This is not a comprehensive list of activities taking place on the site. It is a list of examples to help identify similar activities which may cause harm

English Nature's and Scottish Natural Heritage's advice under Regulation 33(2), operations which may cause deterioration or disturbance		SAC interest features								
		Reefs			Intertidal mudflats and sandflats			Sea caves		Grey seals
Categories of operations	**Examples of current operations***	Rocky shore communities	Kelp forest communities	Subtidal faunal turf	Eelgrass bed communities	Mussel bed communities	Infaunal communities	Subtidal cave communities	Intertidal cave communities	Rocky and coarse sediment shores
Physical damage										
Siltation	Coastal development Coastal defence Dredging for shellfish Maintenance dredging	●●●	●●●●	●●●●	●●●	●●	●●	●●	●●	●●
Abrasion	Anchoring Bait collection Coastal development Coastal defence Dredging for shellfish Land based recreation	●●●	●●●	●●●	●●●●	●●●	●●●	●●●	●●	●●
Selective extraction	Bait collection Diving Shellfishing by hand	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●
Non- physical disturbance										
Noise	Recreational activities (e.g. watersports) Wildfowling	●	●	●	●	●	●	●	●	●●●●
Visual	Bait collection Recreational activities (e.g. water sports, birdwatching and walking) Wildfowling	●	●	●	●	●	●	●	●	●●●●
Toxic contamination										
Introduction of synthetic compounds	Effluent and sewerage discharge Oil and chemical spillage or discharge Capital dredging	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Introduction of non-synthetic compounds	Oil and chemical spillage or discharge Capital dredging	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●

English Nature's and Scottish Natural Heritage's advice under Regulation 33(2), operations which may cause deterioration or disturbance		SAC interest features								
		Reefs			Intertidal mudflats and sandflats			Sea caves		Grey seals
Categories of operations	**Examples of current operations***	Rocky shore communities	Kelp forest communities	Subtidal faunal turf	Eelgrass bed communities	Mussel bed communities	Infaunal communities	Subtidal cave communities	Intertidal cave communities	Rocky and coarse sediment shores
Introduction of radionuclides	-	●●	●●	●●	●●	●●	●●	●●	●●	●●●
Non- toxic contamination										
Nutrient enrichment	Agricultural effluents and run-off Aquaculture Effluent and sewage discharge	●●●	●●●	●●●	●●●●	●●●	●●●	●●	●●●	●●
Organic enrichment	Agricultural effluents and runoff Aquaculture Effluent and sewage discharge	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●●	●●
Change in thermal regime	-	●●	●●●	●●●	●●●	●●	●●●	●●●	●●	●
Changes in turbidity	Coastal development Coastal defence Dredging for shellfish Maintenance dredging	●●	●●●	●●	●●●●	●●	●●●	●●	●●●	●
Changes in salinity	Effluent discharges	●●	●●●	●●●	●●●	●●	●●●	●●●	●●	●
Biological disturbance Introduction of microbial pathogens	Sewage discharges	●●	●●	●●	●●	●●	●●	●●	●●	●●●
Introduction of non-native species and translocation	Aquaculture (e.g. oyster and mussels)	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●

English Nature's and Scottish Natural Heritage's advice under Regulation 33(2), operations which may cause deterioration or disturbance		SAC interest features								
		Reefs			Intertidal mudflats and sandflats			Sea caves		Grey seals
Categories of operations	**Examples of current operations***	Rocky shore communities	Kelp forest communities	Subtidal faunal turf	Eelgrass bed communities	Mussel bed communities	Infaunal communities	Subtidal cave communities	Intertidal cave communities	Rocky and coarse sediment shores
Selective extraction of species	Bait collection e.g. rag worm and lug worm Commercial fisheries (e.g. potting) Diving Wildfowling Shellfishing by hand	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●	●

EN/SNH advice under Regulation 33(2), operations which may cause deterioration or disturbance		Lindisfarne SPA interest features									
		Annex 1 species			Migratory wildfowl			20,000 + assemblage			
Categories of operations	**Examples of current operations***	Intertidal mudflat and sandflat communities	Saltmarsh communities	Eelgrass bed communities	Eelgrass bed communities	Intertidal mudflat and sandflat communities	Saltmarsh communities	Eelgrass bed communities	Intertidal mudflat and sandflat	Saltmarsh communities	Rocky shore communities
Physical loss											
Removal	Coastal development Coastal defence Dredging for shellfish Maintenance dredging Trawling (benthic and demersal fisheries)	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Smothering	Coastal development Coastal defence Dredging for shellfish Maintenance dredging Trawling (benthic and demersal fisheries) Disposal of dredged material	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
Physical damage											
Siltation	Coastal development Coastal defence Dredging for shellfish Maintenance dredging	●●	●●	●●	●●	●●	●●	●●	●●	●●	●●
Abrasion	Anchoring Bait collection Coastal development Coastal defence Dredging for shellfish Land based recreation	●●	●●●	●●	●●	●●	●●●	●●	●●	●●●	●●●
Selective extraction	Bait collection Shellfishing by hand	●●●	●●	●●●	●●●	●●●	●●	●●●	●●●	●●	●●●

* This is not a comprehensive list of activities taking place on the site. It is a list of examples to help identify similar activities which may cause harm

EN/SNH advice under Regulation 33(2), operations which may cause deterioration or disturbance		Lindisfarne SPA interest features									
Categories of operations	**Examples of current operations***	**Annex 1 species**			**Migratory wildfowl**			**20,000 + assemblage**			
		Intertidal mudflat and sandflat communities	Saltmarsh communities	Eelgrass bed communities	Eelgrass bed communities	Intertidal mudflat and sandflat communities	Saltmarsh communities	Eelgrass bed communities	Intertidal mudflat and sandflat	Saltmarsh communities	Rocky shore communities
Non- physical disturbance											
Noise	Recreational activities (e.g. watersports) Wildfowling	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Visual	Bait collection Recreational activities (e.g. boating, birdwatching, walking) Wildfowling	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Toxic contamination											
Introduction of synthetic compounds	Effluent and sewerage discharge Oil and chemical spillage or discharge	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
Introduction of non-synthetic compounds	Oil and chemical spillage or discharge	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
Introduction of radionuclides	-	●●	●●	●●	●●	●●	●●	●●	●●	●●	●●
Non- toxic contamination											
Nutrient enrichment	Agricultural effluents and run-off Aquaculture Effluent and sewage discharge	●●●	●●	●●●	●●●	●●●	●●	●●●	●●●	●●	●●●
Organic enrichment	Agricultural effluents and run-off Aquaculture Effluent and sewage discharge	●●●	●●	●●●	●●●	●●●	●●	●●●	●●●	●●	●●●
Change in thermal regime	-	●●	●	●	●●	●	●	●●	●	●	●
Changes in turbidity	Coastal development	●●	●	●●	●●	●	●	●●	●	●	●

EN/SNH advice under Regulation 33(2), operations which may cause deterioration or disturbance		Lindisfarne SPA interest features									
Categories of operations	**Examples of current operations***	**Annex 1 species**			**Migratory wildfowl**			**20,000 + assemblage**			
		Intertidal mudflat and sandflat communities	Saltmarsh communities	Eelgrass bed communities	Eelgrass bed communities	Intertidal mudflat and sandflat communities	Saltmarsh communities	Eelgrass bed communities	Intertidal mudflat and sandflat	Saltmarsh communities	Rocky shore communities
Changes in salinity	-	●●●	●	●●	●●●	●●	●	●●●	●●	●	●●
Biological disturbance											
Introduction of microbial pathogens	Sewage discharge	●●	●	●●	●●	●●	●	●●	●●	●	●●
Introduction of non-native species and translocation	Aquaculture (eg oysters and mussels)	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
Selective extraction of species	Bait collection (e.g. rag worm and lug worm) Commercial fisheries (eg. potting) Diving Wildfowling Shellfishing by hand	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●

[6]English Nature's and Scottish Natural Heritage's advice on operations is derived from an assessment combining relative sensitivity of the features or sub-features with information on human usage of the site (as at November 1999), to identify relative vulnerability to categories of operations. In accordance with Government policy guidance this advice is provided in the light of current activities and patterns of usage at the site. It is important therefore that future consideration of this advice by relevant authorities, and others, takes account of changes in the usage patterns at the site. In contrast, the sensitivity of interest features, or sub-features, is relatively stable with alterations reflecting improvement in our scientific knowledge and understanding. To this end, information on sensitivity has been included in this table to assist the management and advisory groups with the future management of the site.

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10 Glossary

Abiotic	Non biological, physical parameters and/or influences.
Annex I habitats	A natural habitat(s) listed in Annex 1 of the Habitats Directive for which Special Areas of Conservation can be selected.
Annex II Species	A species listed in Annex II of the Habitats Directive for which Special Areas of Conservation can be selected.
Annex IV Species	A species listed in Annex IV of the Habitats Directive in need of strict protection.
Assemblage	A collection of plants and/or animals characteristically associated with a particular environment.
Attribute	Characteristic of an interest feature/sub-feature which provides an indication of the condition of the interest feature or sub-feature to which it applies.
BAP	Biodiversity Action Plan.
Benthos	Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides.
Biogeographical transitions	The gradual change in community composition due to geographical influences.
Biotope	The physical habitat with its biological community; a term which refers to the combination of physical environment and its distinctive assemblage of conspicuous species.
Characteristic	Special to or especially abundant in a particular situation or biotope. Characteristic species should be immediately conspicuous and easily identified.
Circalittoral	The rocky subtidal zone below that dominated by algae (animal dominated subtidal zone).
Community	A group of organisms occurring in a particular environment, presumably interacting with each other and with the environment, and identifiable by means of ecological survey from other groups.
Competent authority	Any minister, government department, public or statutory undertaker, public body or person holding a public office that exercises legal powers (see also relevant authority).
Conservation Objective	A statement of the nature conservation aspirations for the site expressed in terms of the favourable condition that we wish to see the species and/or habitats for which the site has been selected to attain. Conservation objectives for European marine sites relate to the aims of the Habitats Directive.
Eulittoral	The main part of the intertidal zone characterised by limpets, barnacle, mussels, fucoid algae and with red algae often on the lower part.
European marine site	A European site (SAC or SPA) which consists of, or in so far as it consists of, marine areas.
Favourable Condition	A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function within an individual Natura 2000 site in the long term. The condition in which the habitat or species is capable of sustaining itself on a long term basis.
Favourable Conservation status	A range of conditions for a natural habitat or species at which the sum of influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function through the EC in the long term. The condition in which the habitats or species is capable of sustaining itself on a long term basis.
Flocculation	The action of clay particles sticking together in saline conditions, effectively increasing particle size, encouraging settlement.
Fluvial	Produced by rivers, fluvial sediments are bought into the system by rivers.
GIS	Geographical Information systems. A system for capturing, storing, checking, integrating, manipulating

	analysing and displaying digital data which are spatially referenced to a geographical region.
Geomorphology	The study of the form of the earth's crust and the processes which shape the physical features of the earth's surface. In estuarine terms this means the form and function of the estuary and its inter-relationship with processes elsewhere.
Habitat	The place in which an animal or plant lives.
Habitats Directive	The abbreviated term for *Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora*. It is the aim of this Directive to promote the conservation of certain habitats and species within the European Union.
Halophyte	A plant which is adapted to life in saline conditions.
Infralittoral	The subtidal zone in which upward facing rocks are dominated by erect algae, typically kelps.
Integrity	The coherence of the sites' ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or levels of populations of the species for which it was classified.
Interest Feature	A natural or semi-natural feature for which a European site has been selected. This includes the Habitats Directive Annex 1 habitat, or specific component of their fauna and flora, or any Annex II species and any population of bird species for which an SPA has been designated under the Birds Directive. Any habitat of a species for which the site has been selected, or typical species of an Annex 1 habitat are also considered to be interest features.
Isostatic uplift	The upwards movement of land in relation to the sea.
Littoral	The margins of a body of water, an area which is occasionally washed by the tide.
Maintain	The action required for an interest feature when it is considered to be in favourable condition.
Management group	The body of relevant authorities formed to manage the European marine site.
Management scheme	The framework established by the relevant authorities at a European marine site under which their functions are exercised to secure, in relation to that site, compliance with the requirements of the Habitats Directive.
Nationally scarce/rare	For marine purposes, these are regarded as species of limited national occurrence.
Natura 2000	The European network of protected sites established under the Birds Directive and the Habitats Directive.
NVC	National Vegetation Classification - a classification system for plant communities to provide standardised descriptions of names and systematically arranged vegetation types from all natural, semi-natural and major artificial habitats in England, Scotland and Wales, using a standard methodology.
Operations which may cause deterioration or disturbance	Any activity or operation taking place within, adjacent to, or remote from a European marine site that has the potential to cause deterioration to the natural habitats for which the site was designated or disturbance to the species and its habitats for which the site was designated.
Plan or project	Any proposed development that is within a relevant authority's function to control, or over which a competent authority has a statutory function to decide on applications for consents, authorisations, licences or permissions.
Ramsar site	A site held on the list of wetlands of international importance, especially as habitats for wildfowl, under the Ramsar convention.
Relevant authority	The specific competent authority which has powers or functions which have, or could have, an impact on the marine environment within or adjacent to a European marine site.
Reporting cycle	Six year period after which the countryside agencies have a duty to report to Europe.
Restore	The action required for an interest when it is not considered to be in a favourable condition.
Saltmarsh terrace	Terraces formed during rapid stages of salt marsh development and isostatic uplift of land.
Saltpan	A hollow within saltmarsh once filled with water which has evaporated, leaving behind a saltpan.

Sediment budget	Sediment within the system, being imported or lost.
Sensitivity	The intolerance of a habitat, community or individual of a species to damage from an external factor.
Special Area of Conservation (SAC)	An area designated under the European Habitats Directive 92/43/EEC.
Special Protection Area (SPA)	An area designated under the European Birds Directive 79/409/EEC.
Sublittoral	An area constantly covered by the sea.
Typical species	A species and its habitat that is considered to be a typical component of an interest feature.
Vulnerability	The exposure of a habitat, community or individual of a species to an external factor to which it is sensitive.

11 Appendices

Appendix 1 Summary of reef biotopes

Table 1 Rocky shore biotopes

Location	Summary of main biotopes
Fast Castle Head-Eyemouth	Rock with mussels and barnacles (MytB, Ala.Myt). Rock with fucoids and barnacles (BPat.Sem, FvesB, Ldig.Ldig).
Eyemouth-Tweed Estuary	Rock with mussels and barnacles (MytB, Ala, Ldig). Rock with fucoids and barnacles (BPat.Sem, FvesB, Ldig.Ldig).
Tweed estuary-Bamburgh	Rock with fucoids and barnacles (BPat.Sem, FvesB, Ldig.Ldig). Boulders and cobbles with Mytilus edulis beds (MytX).
Farne Islands	Littoral rock with barnacles and mussels (MytB, Him, Ala.Myt). Rock with fucoids and barnacles (BPat.Sem, Fves. Ldig.Ldig).
Bamburgh-Alnmouth	Rock with mussels and barnacles (MytB, Ala.Ldig). Rock with fucoids and barnacles (BPat.Sem, FvesB, Ldig.Ldig). Rock with fucoid algae (Fves, Fser.Fser).

Table 2 Kelp forest biotopes

Location	Summary of main biotopes
Fast Castle Head-Eyemouth	Kelp forest with red algae (Lhyp.Ft). Tide swept kelp with dense red algae (LhypR.Ft, LhypFa).
Eyemouth-Tweed Estuary	Kelp forest/park with red algae (Lhyp.Ft, Lhyp.Pk). Kelp park with red algae (Lhyp.Pk).
Tweed estuary-Bamburgh	Tide swept kelp and dense red algae (Lhyp.TFt, Lhyp.TPk).
Farne Islands	Kelp forest/park with red algae (Lhyp.Ft, Lhyp.Pk, LhypGz.Ft, LhypGz.Pk). Rock with sparse kelp, brittlestars and hydroids (LhypGz.Pk, Oph). Tide swept kelp with dense red algae (Lhyp.TFt, Lhyp.TPk).
Bamburgh-Alnmouth	Kelp park with red algae (Lhyp.Ft, Lhyp.Pk). Rock with kelp, brittlestars, bryzoans and hydroids (LhypGz.Pk, Oph).

Table 3 Subtidal faunal turf biotopes

Location	Summary of main biotopes
Fast Castle Head-Eyemouth	Tide swept circalittoral rock with dense *Alcyonium digitatum* (AlcC). Tide swept circalittoral rock with dense *A. digitatum* and hydroid turf (AlcSec). Circalittoral rock with sparse *A. digitatum* and faunal turf (FaAlC). Circalittoral rock with brittle stars and hydroids (Oph).
Eyemouth-Tweed Estuary	Tide swept circalittoral rock with *A. digitatum* and hydroid turf (AlcSec). Circalittoral rock with sparse *A. digitatum* and faunal turf (FaAlC). Circalittoral rock with brittle stars and hydroids (Oph).
Tweed estuary-Bamburgh	Tide swept circalittoral rock with dense *A. digitatum* and hydroid turf (AlcSec). Circalittoral rock with sparse *A. digitatum* and faunal turf (FaAlC). Circalittoral rock with brittle stars and hydroids (Oph).
Farne Islands	Tide swept circalittoral rock with dense *A. digitatum* (AlcC). Tide swept circalittoral rock with *A. digitatum* and hydroid turf (AlcTub, AlcSec). Moderately exposed rock with brittlestars and hydroids (Oph).
Bamburgh-Alnmouth	Circalittoral rock with hydroids and bryzoans (Flu.Flu). Circalittoral rock with sparse *A. Digitatum* and faunal turf (FaAlC). Circalittoral rock with brittle stars and hydroids (Oph).

Appendix 2 Summary of intertidal mudflats and sandflats biotopes

Location	Summary of main biotopes
Fast Castle Head-Eyemouth	Very little littoral sediment habitat present. Mobile sand shores with amphipods and polychaetes (AP.P).
Eyemouth-Tweed Estuary	No littoral sediment habitat present.
Tweed estuary-Bamburgh	Mobile sand shores with amphipods and polychaetes (AEur, AP.Pon). Muddy sand and mud shores with polychaetes, bivalves and *Zostera nolti* (HedMac.Are, Znol). Boulders and cobbles with *Mytilus edulis* beds (MytX).
Budle Bay	Medium to fine sand with amphipods and polychaetes (AP.Pon, AP.P). Muddy sand shores with polychaetes and *Corophium volutator* (HedMac.Are, MacAre).
Farne Islands	Infralittoral fine sand with polychaetes and bivalves (FabMag).
Bamburgh-Alnmouth	Mobile sand shores with amphipods and polychaetes (AEur, AP.Pon). Muddy sand shores with polychaetes and bivalves (MacAre).

Appendix 3 Sea cave biotopes

Table 1 Intertidal sea caves

Biotope code	Biotope description
LR.CvOv SFa	Sparse fauna (barnacles and spirorbids) in scoured mid or lower shore caves.
LR.CvOv BarCC	Barren or Coralline crust-covered rock on severely scoured cave walls and floors.
LR.CvOv RhoCv	*Rhodothamniella floridula* on shaded vertical rock in upper and mid shore caves.
LR.CvOv GCv	Green algal film (? *Pseudendoclonium submarinum*) on upper shore cave walls and ceilings.
LR.CvOv Br	Brown algal crusts (? *Pilinia maritima*) on upper shore caves.
LR.CvOv Vmuc	*Verrucaria mucosa* and *Hildenbrandia rubra* on shaded vertical or overhanging rock in upper- and mid-shore caves
LR.CvOv FaC	*Verrucaria mucosa* and *Hildenbrandia rubra* on shades vertical or overhanging rock in upper and mid shore caves.
LR.CvOv RCv	Faunal encrusted vertical rock on mid or lower shore wave surged caves.
LR.CvOv SR	Red algal dominated cave entrance on lower shore.
LR.CvOv SR.Ov	Sponges and shade tolerant red seaweeds on steep or overhanging lower eulittoral bedrock.
LR.CvOv SR.Cv	Sponges and shade tolerant red seaweeds on open shore overhanging bedrock in lower eulittoral.
LR.CvOv SByAs	Sponges and shade tolerant red seaweeds on steep or overhanging wave surged bedrock in aces.
LR.CvOv SByAs.Ov	Sponges, bryozoans and ascidians on deeply overhanging lower shore bedrock.
LR.CvOv SByAs.Cv	Sponges, bryozoans and ascidians on deeply overhanging wave surged bedrock in lower shore caves.

NB. Biotopes in this section have been redefined since Connor *et al*. (1997). Codes and names listed here are from Tim Hill (pers. Comm. July, 1999)

Table 2 Sublittoral cave communities

Biotope code	Biotope description
SCAn	Sponge crusts and anemones on wave surged vertical infralittoral rock.
SCAn.Tub	Sponge crusts, anemones and *Tubularia indivisa* in shallow infralittoral surge gullies.
SCAs	Sponge crusts and colonial ascidians on wave surged vertical infralittoral rock.
SCAs.DenCla	*Dendrodoa grossularia* and *Clathrina coriacea* on wave surged vertical infralittoral rock.
SCAs.ByH	Sponge crusts, colonial (polyclinid) ascidians and a bryozoan/hydroid turf on wave surged vertical or overhanging infralittoral rock.

Appendix 4 Matrix of relative vulnerability

The relative vulnerability of an interest feature or sub-feature is determined by multiplying the scores for relative sensitivity and exposure, and classifying that total into categories of relative vulnerability.

		Relative sensitivity of the interest feature			
		High (3)	Medium (2)	Low (1)	None detectable (0)
Relative exposure of the interest feature	High (3)	**9**	**6**	**3**	**0**
	Medium (2)	**6**	**4**	**2**	**0**
	Low (1)	**3**	**2**	**1**	**0**
	None (0)	**0**	**0**	**0**	**0**

Categories of relative vulnerability

High	**6 - 9**
Medium	**3 - 5**
Low	**1 - 2**
None detectable	**0**

Appendix 5 Maps

Appendix 6 Berwickshire and North Northumberland Coast European marine site management group

Relevant authority	Contact details
Alnwick District Council. ADC	Senior planner 01665 510 505
Berwick Harbour Commissioners. BHC	Harbour Master 01289 307 404
Berwick upon Tweed Borough Council. BBC	Borough Surveyor cb@berwick-upon-tweed.gov.uk Borough Development Plan Officer slin@berwick-upon-tweed.gov.uk 01289 330 044
East of Scotland Water. ESW	Environment & Quality Officer 0131 445 6426
English Nature. EN	Marine Conservation Officer 01661 845500
The Environment Agency. EA	Area FER Manager 0191 203 4040
Eyemouth Harbour Trust. EHT	Harbour Master 018907 50 223
Government Office, North East. GONE	Land Use Planning Team 0191 202 3635
Maritime and Coastguard Agency. MCA	District Controller 0191 257 2681
Ministry of Agriculture, Fisheries and Food. MAFF	District Inspector of Fisheries 0191 257 4520 CEFAS laboratory, Burnam on Crouch 01621 721 087
National Trust. NT	Coastal Site Manager 01665 720 651
North Sunderland Harbour Commissioners. NSHC	Harbour Master 01665 720 033
Northern Lighthouse Board NLB	Mr I Webster 0131 226 7051
Northumberland County Council NCC	Head of Countryside Service 01670 53 4070
Northumberland Sea Fisheries Committee NSFC	Chief Fishery Officer 0191 266 7891
Northumbrian Water Limited. NWL	Dr Chris Spray 0191 383 2222
River Tweed Commissioners. RTC	Clerk to the River Commissioners 01896 848 294
Scottish Borders Council. SBC	Head of Planning & Development 01835 824 000
Scottish Environment Protection Agency. SEPA	Head of Tidal Water Section 0131 449 7296
Scottish Executive Rural Affairs Department SERAD	Head of Rural Affairs Section 0131 244 4415
Scottish Natural Heritage SNH	Natura 2000 Officer - Galashiels 01896 756 652
Trinity House. TH	Estates and Planning Officer 0171 481 6914

Appendix 7 Plans and projects and review of consents

Plans and Projects

Under Regulation 48(1), an appropriate assessment needs to be undertaken in respect of any plan or project which:

a. either alone or in combination with other plans or projects would be likely to have a significant effect on a European Site; and
b. is not directly connected with the management of the site for nature conservation.

An appropriate assessment is required by law for all European Sites (Regulation 48). A European Site is any classified SPA and any SAC from the point where the Union and the Government agree the site as a Site of Community Importance. Appropriate assessment is also required, currently as a matter of Government policy, for potential SPAs, candidate SACs and listed Ramsar Sites for the purpose of considering development proposals affecting them. (PPG 9 paras 13 and C7). It should be noted however, that amendments to the Habitats Regulations are now in force which will result in the statutory obligations within the Regulations being applied to candidate SACs earlier in the process than previously. English Nature's Habitats Regulations Guidance Note: The Appropriate Assessment (Regulation 68) is at Appendix 8 for further information.

This advice provides relevant authorities with a guide against which to initiate an assessment of the "significance" of any plans or projects (and ongoing operations or activities) proposed for the site although this will only be the starting point for assessing impacts and does not remove the need for relevant authorities to formally consult English Nature over individual plans and projects where required under the Regulations.

Review of Consents

Regulation 50 of the Conservation (Natural Habitats &c.) Regulations 1994 requires competent authorities to undertake a review of all existing consents and permissions affecting SAC and SPAs, as soon as possible after the site officially becomes a Site of Community Importance. This will have implications for discharge and other consents, which will need to be reviewed in the light of these objectives and may mean that lower targets for background levels of contaminants etc. will need to be set.