Cyfoeth Naturiol Cymru
Natural Resources Wales

Cardigan Bay/ Bae Ceredigion Special Area of Conservation

Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017.

March 2018

Contents

Summary

This document contains NRW's advice issued under Regulation 37 of the Conservation Regulations 2017, for the *Cardigan Bay Special Area of Conservation* namely conservation objectives and advice on operations. It also includes an explanation of the purpose and format of NRW's "Regulation 37 advice".

This latest version of the Regulation 37 package has been revised to improve accessibility of conservation objectives and to update the legislative context. The intent of the conservation objectives and of the advice on operations which may cause deterioration or disturbance to the feature is the same as in previous versions. The Conservation Objectives are now more accessible but there has been no change in what is considered to represent Favourable Conservation Status.

***Table 1 summaries the features for the site and provides a direct link to the Conservation Objectives but it is important that all sections are read in full*.**

This report is divided into a series of sections as follows:
Section 1 is a brief introduction to the legal context for Regulation 37 advice.

Section 2 explains in more detail the legal basis and practical requirements for setting conservation objectives for Natura 2000 sites, as understood by NRW. It also explains the legal and practical basis of the operations advice.

Section 3 contains a brief overall description of *Cardigan Bay Special Area of Conservation*, current operations taking place with the SAC and information on modifications as a result of human activity.

Section 4 describes habitats and species for which the *Cardigan Bay Special Area of Conservation* has been selected as a SAC as well as why they are considered important. The information is presented using the same headings as those used to describe the conservation objectives so that useful underpinning information in support of these objectives can easily be referenced.

Section 5 contains NRW's advice as to the conservation objectives (Regulation 37(3)(a)) for the features for which the site has been as a SAC. This includes a vision statement which is a descriptive overview of what needs to be achieved for conservation on the site. It brings together and summarises the Conservation Objectives into a single, integrated statement about the site.

Section 6 contains NRW's advice as to the operations which may cause deterioration or disturbance of the habitats and species for which the site has been selected (Regulation 37(3)(b)). This is provided to assist the relevant authorities and others in understanding the implications of the designation of the site and the requirements of the Habitats Regulations and government policy towards it.

Table 1: Summary of site features and link to conservation Objectives.

Site Name	Designated Features	Conservation Objective
Cardigan Bay / Bae Ceredigion SAC	**Habitats:** • Sandbanks which are slightly covered by seawater all the time • Reefs • Submerged or partially submerged sea caves	Conservation Objectives
	Species: • Bottlenose dolphin *Tursiops truncates* • Grey seal *Halichoerus grypus* • River lamprey *Lampetra fluviatilis* • Sea lamprey *Petromyzon marinus*	

Crynodeb

Mae'r ddogfen hon yn cynnwys cyngor gan CNC a roddwyd dan Reoliad 37 Rheoliadau Cadwraeth 2017, ar gyfer *Ardal Cadwraeth Arbennig Bae Ceredigion*, sef amcanion cadwraethol a chyngor ynghylch gweithrediadau. Mae hefyd yn cynnwys esboniad o bwrpas a fformat "cyngor Rheoliad 37" CNC.

Mae fersiwn ddiweddaraf y pecyn Rheoliad 37 wedi'i ddiwygio er mwyn gwella'r modd y gellir asesu amcanion cadwraethol a diweddaru'r cyd-destun deddfwriaethol. Mae diben yr amcanion cadwraethol a'r cyngor ynghylch gweithrediadau a allai ddirywio neu amharu ar y nodweddion yr un fath ag yn y fersiynau blaenorol. Yn awr mae'r Amcanion Cadwraethol yn fwy hygyrch, ond ni chyflwynir unrhyw newid o ran yr hyn a ystyrir fel Statws Cadwraethol Ffafriol.

Mae Tabl 1 yn rhestru'r nodweddion ar gyfer y safle a hefyd cynhwysir dolen sy'n arwain yn syth at yr Amcanion Cadwraethol, ond mae'n bwysig i'r holl adrannau gael eu darllen yn llwyr.

Caiff yr adroddiad hwn ei rannu'n gyfres o adrannau, fel a ganlyn:
Yn **Adran 1** ceir cyflwyniad byr i gyd-destun cyfreithiol cyngor Rheoliad 37.

Mae **Adran 2** yn esbonio'n fwy manwl y sylfaen gyfreithiol a'r gofynion ymarferol wrth bennu amcanion cadwraethol ar gyfer safleoedd Natura 2000, fel y'u deellir gan CNC. Ymhellach, mae'n esbonio'r sylfaen gyfreithiol ac ymarferol parthed cyngor ynghylch gweithrediadau.

Mae **Adran 3** yn cynnwys disgrifiad cyffredinol byr o *Ardal Cadwraeth Arbennig (ACA) Bae Ceredigion*, y gweithrediadau sydd ar waith ar hyn o bryd oddi mewn i'r ACA a gwybodaeth am addasiadau o ganlyniad i weithgareddau pobl. Yn yr adran hon hefyd ceir disgrifiad byr o'r tair Ardal Gwarchodaeth Arbennig sydd i'w cael naill ai'n gyfan gwbl neu'n rhannol oddi mewn i ffiniau'r ACA.

Yn **Adran 4** ceir disgrifiad o'r cynefinoedd a'r rhywogaethau sy'n sail i'r rheswm pam y dewiswyd *Ardal Cadwraeth Arbennig Bae Ceredigion*, yn ogystal â pham y cânt eu hystyried yn bwysig. Caiff yr wybodaeth ei chyflwyno trwy ddefnyddio'r un penawdau â'r rheini a ddefnyddir i ddisgrifio'r amcanion cadwraethol, fel y gellir cyfeirio'n rhwydd at wybodaeth ategol ddefnyddiol sy'n cefnogi'r amcanion hyn.

Mae **Adran 5** yn cynnwys cyngor CNC parthed amcanion cadwraethol (Rheoliad 37(3)(a)) y nodweddion sy'n sail i ddynodiad yr ACA. Mae hyn yn cynnwys datganiad gweledigaeth sy'n drosolwg disgrifiadol o'r hyn y mae angen ei gyflawni o safbwynt cadwraeth ar y safle. Mae'n dwyn ynghyd ac yn crynhoi'r Amcanion Cadwraethol mewn un datganiad integredig ynglŷn â'r safle.

Yn **Adran 6** ceir cyngor CNC o safbwynt y gweithrediadau a allai ddirywio neu amharu ar y cynefinoedd a'r rhywogaethau y cafodd y safle ei ddewis o'u herwydd (Rheoliad 37(3)(b)). Nodir y cyngor hwn er mwyn cynorthwyo'r awdurdodau perthnasol ac eraill i ddeall goblygiadau dynodiad y safle a gofynion y Rheoliadau Cynefinoedd a pholisïau'r llywodraeth.

Tabl 1: Crynodeb o nodweddion y safle a dolen yn arwain at yr Amcanion Cadwraethol.

Enw'r Safle	Nodweddion Dynodedig	Cysylltiad â'r Amcanion Cadwraethol
Bae Ceredigion ACA	**Cynefinoedd:** • Ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser • Riffiau • Ogofâu môr sy'n danforol neu'n lleddanforol	Amcanion Cadwraethol
	Rhywogaethau: • Dolffin trwyn potel *Tursiops truncates* • Morlo llwyd *Halichoerus grypus* • Lamprai neu lysywen bendoll yr afon *Lampetra fluviatilis* • Lamprai neu lysywen bendoll y môr *Petromyzon marinus*	

1. Introduction

The 1992 EC Habitats Directive[1] aims to help conserve the diversity of habitats and species across the European Union. The Habitats Directive requires member states to take a variety of measures aimed at the conservation of biodiversity. These measures include the designation of Special Areas of Conservation (SACs) on land and sea. Each SAC is to be designated for particular habitats and/or species, and they are to be managed in ways that help conserve those habitats and species.

The Habitats Directive is given effect in the UK largely through the Conservation of Habitats and Species Regulations 2017 ("the Habitats Regulations")[2]. These Regulations set out the powers and duties of UK statutory bodies towards compliance with the requirements of the Habitats Directive. Under these Regulations SACs, together with Special Protection Areas (SPAs) classified under the 1979 EC Birds Directive for the conservation of birds, are called "European sites" and those that include marine areas are called "European marine sites".

Regulation 37 of the Habitats Regulations requires Natural Resources Wales (NRW) to advise the relevant authorities[3] for each European marine site in, or partly in, Wales as to "(a) the conservation objectives for that site, and (b) 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 document contains NRW's advice under Regulation 37 in relation to the Cardigan Bay EMS.

None of the information contained in this document legally binds any organisation (including NRW) to any particular course of action. However, in exercising their functions in accordance with the requirements of the Habitats Directive, as required by the Habitats Regulations, and in accordance with government policy towards Ramsar sites, the relevant authorities should be guided by the advice contained in this document. This applies to, amongst other things, the establishment of a "management scheme"[4], if such a scheme is established.

Relevant authorities and others may have obligations towards the conservation of habitats and species that are not features for which the Cardigan Bay EMS has been designated, and such obligations are not affected by this document.
The information contained in this document is based on best available knowledge at time of writing and is subject to review at NRW's discretion. Further guidance relating to European marine sites is published by the National Assembly for Wales (*European marine sites in England and Wales*, June 1998, Department of the Environment and Welsh Office), CCW (*European marine sites: an introduction to management*, 1998, CCW Bangor) and European Commission (*Guidelines for the establishment of the Natura 2000 network in the marine environment. Application of the Habitats and Birds Directive May 2007)*.

[1] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (OJ No L 206)
[2] https://www.legislation.gov.uk/uksi/2017/1012/contents/made
[3] Defined in regulation 6 of the Habitats Regulations
[4] Regulation 38 of the Habitats Regulations.

2. Purpose and format of information provided under Regulation 37

The information provided under Regulation 37 is in two parts: the conservation objectives and the advice on operations. The legal context for each of these elements, the format of the advice and its underlying rationale are explained here. Sections 4 (conservation objectives) and 5 (operations advice) should be read in conjunction with these explanatory notes.

2.1 Conservation Objectives Background

2.1.1 Legal Background

The conservation objectives for a European marine site are intended to represent the aims of the Habitats and Birds Directives in relation to that site. The Habitats Directive requires that measures taken under it, including the designation and management of SACs, be designed to maintain or restore habitats and species of European Community importance at "favourable conservation status" (FCS), as defined in Article 1 of the Directive (see Box 1).

Box 1: Favourable conservation status as defined in Article 1 of the Habitats Directive

Conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2.

The conservation [sic] status of a natural habitat will be taken as 'favourable' 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, and
- conservation status of typical species is favourable as defined in [Article] 1(i).

Conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term natural distribution and abundance of its populations within the territory referred to in Article 2;

The conservation status will be taken as 'favourable' when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a longterm basis as a viable component of its natural habitat(s), and
- the natural range of the species is neither being reduced, nor is likely to be reduced, for the foreseeable future and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Guidance from the European Commission[5] indicates that the Directive intends FCS to be applied at the level of an individual site, as well as to habitats and species across their European range. Therefore, in order to properly express the aims of the Habitats Directive

[5] European Commission (2000). *Managing Natura 2000 sites: the provisions of Article 6 of the Habitats Directive 92/43/EEC*. DGXI, Brussels, p.18.

for an individual site, the conservation objectives for a site are essentially to maintain (or restore) the habitats and species of the site at (or to) FCS.

2.1.2 Practical Requirements

In practical terms, the conservation objectives for a site set the standards which must be met if the habitats and species (collectively referred to as "features") are to be at FCS. There are four elements to this. The conservation objectives must;

1) form the basis for proactively identifying what actions, if any, need to be taken by those bodies responsible for the management of operations in and around the site, in order to conserve the features.
2) inform the consideration of proposed developments, or "plans or projects"[6], which are likely to significantly affect the features of the site. In order for a plan or project to proceed, it must be ascertained that it will *not* adversely affect the "integrity of a site"[7]. This depends on whether or not the plan or project will adversely affect the conservation status of one or more of the features and therefore requires direct reference to the conservation objectives.
3) set the standard against which NRW reports to government on the conservation status of the features on the site. Government in turn will use this information, together with that from other SACs and on the status of habitats and species outside designated sites, to report to the EC on the implementation and effectiveness of the Habitats Directive.
4) set the standard against which the appropriateness of management can be judged. If the conservation objectives are not being met it may be due to inappropriate management of the site or to factors originating outside the site or outside the control of those responsible for management, or a combination.

To achieve this we provide conservation objectives covering all the elements of FCS as set out in the Directive, at the same time as being suitable for guiding the preparation of management plans and testing the acceptability or otherwise of the effects of plans and projects. Box 2 indicates the various aspects of conservation status described in this package to help explain the conservation objectives. NRW also uses a related set of "performance indicators" which supports monitoring[8] and allows judgements to be made about site condition[9] and conservation status of features for purposes such as reporting and review of management.

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[6] Plans and projects are certain types of operation that the Habitats Directive and Regulations require be subject to specific procedures. Plans or projects considered likely to have a significant effect on a European (marine) site must be subject to appropriate assessment of their implications for the site in view of the site's conservation objectives. The carrying out of an appropriate assessment must include consultation with NRW, and such consultation is a separate process to the advice in this document. The information in this document is intended to assist in the identification of plans and projects which are likely to require appropriate assessments, and will form the basis for advice given by NRW in relation to individual plans and projects.

[7] "Integrity of the site" is not defined in the legislation, but has been defined by the UK government as "the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified [i.e. designated]". This definition is similar in intent to FCS.

[8] Monitoring is defined as "Surveillance undertaken to ensure that formulated standards are being maintained. The term is also applied to compliance monitoring against accepted standards to ensure that agreed or required measures are being followed." (*A statement on Common Standards Monitoring*, 1998, Joint Nature Conservation Committee, Peterborough, http://www.jncc.gov.uk/page-2198)

[9] The status of the site at a particular moment in time.

The results of the monitoring of feature condition, combined with information on security and suitability of management and the results of surveillance support the making of judgements about whether or not the conservation objectives are being met. Knowledge of the dynamics of many marine species and communities and their sensitivity is limited. Accordingly, in many cases it is not yet possible to identify values above or below which conservation status would be considered unfavourable. When there is a dearth of information the precautionary principle is to be applied. Surveillance[10] is necessary to:

- gain a greater understanding of feature and factor variability,
- provide information which can assist in the interpretation of the results of monitoring of the performance indicators *e.g.* information on trends in other attributes and factors can assist the identification of the causes of changes observed in the performance indicators;
- improve the overall level of understanding of the site, its features and the factors affecting them.

Box 2: Elements of favourable conservation status described in this document to help explain the conservation objectives*

(i) For each HABITAT feature

- RANGE – including distribution and extent
- STRUCTURE & FUNCTION – including geology, sedimentology, geomorphology, hydrography & meteorology, water and sediment chemistry and biological interactions
- TYPICAL SPECIES – including species richness/eveness, population dynamics and range and as defined for species features (below)
- NATURAL PROCESSES

(ii) For each SPECIES feature

- POPULATION – including size, structure, production and physiological health
- RANGE – including areas of the site which the population/individuals use
- SUPPORTING HABITATS & SPECIES – including distribution and extent, structure, function and quality and prey availability & quality.

For both habitats and species information is provided on natural processes, current condition and modifications as a result of human activity.

*The information is limited by the availability of data and in many cases our understanding of these elements in particular locations is incomplete. All descriptions are therefore based on the best available information at the time of writing.

The performance indicators and surveillance requirements for the features of the site are not included in this document. Each of the habitat features of the SAC represents part of the range and variation of that feature within the UK and Europe. The SAC and all its features makes up part of a suite of sites across the UK that were selected to represent the range and variation of all relevant features within the UK, and to become part of the pan-European network of conservation areas – Natura 2000. Additional information about the selection of SACs in the UK is provided on the website of the Joint Nature Conservation Committee[11].

[10] Surveillance is defined as “a continued programme of surveys systematically undertaken to provide a series of observations in time” (*A statement on Common Standards Monitoring*, 1998, Joint Nature Conservation Committee, Peterborough. http://www.jncc.gov.uk/page-2198)

[11] http://jncc.defra.gov.uk/sacselection

2.2 Operations which may cause deterioration or disturbance

2.2.1 Legal context

NRW's specific duty in Regulation 37 to give advice on operations that are potentially damaging needs to be seen in the context of the Habitats Directive, which requires that for a SAC:

- the necessary conservation measures are established which correspond to the ecological requirements of the habitats and species on the site;
- appropriate steps are taken to avoid deterioration of habitats and significant disturbance of species.
- any plan or project which is likely to have a significant effect on a site is subject to an appropriate assessment in view of the site's conservation objectives.

The operations advice, in combination with the conservation objectives, is designed to assist relevant authorities and other decision-makers in complying with these provisions. The operations advice given in this document is without prejudice to other advice given, including the conservation objectives themselves and other advice which may be given by NRW from time to time in relation to particular operations.

The term "operations" is taken to cover all types of human activity, irrespective of whether they are under any form of regulation or management[12]. This is because the obligations in the Directive are defined by the conservation requirements of the habitats and species, not by existing regulatory or management regimes. Thus the advice contains reference to operations which may not be the responsibility of any of the relevant authorities.

2.2.2 Practical Requirements

Operations manifest themselves through one or more factors[13]. The conservation status of a given habitat or species could potentially be affected by many different types of factor, and hence many different types of operation[14]. The key practical purpose of the Regulation 37 operations advice is to assist in the identification of priorities for management, by identifying operations to which features are both 'sensitive' and 'vulnerable'. Sensitivity is defined as 'the intrinsic intolerance of a habitat, community or individual of a species to damage from an external factor.' Vulnerability is defined as 'the likelihood of exposure of a habitat, community or individual of a species to a factor to which it is sensitive'[15]. Thus the potential for an operation to deteriorate or disturb a feature depends both on the sensitivity of the feature to the operation – through its associated factors - and the location, intensity, duration and frequency of the operation and the factors that it affects or causes.

Formulating the operations advice has three main elements:

1. Identifying factors to which the features are sensitive.
2. Identifying the types of operation that can cause or affect those factors.

[12] The term also includes what the Habitats Directive and Regulations call "plans and projects" (see footnote 6).
[13] A factor is defined as "A component of the physical, chemical, ecological or human environment that may be influenced by a natural event or a human activity" (*Sensitivity and mapping of inshore marine biotopes in the southern Irish Sea (Sensmap): Final report.* CCW, Bangor, December 2000.)
[14] The complexity of formulating operations advice is compounded by the "many-to-many" relationship that exists between operations and factors, where an operation may manifest itself through several factors, and a factor may be affected by several operations, in different ways and to different magnitudes.
[15] Adapted from Hiscock (1996)

3. Assessing the likelihood of those factors (and hence the features) being affected by those operations, in other words assessing the vulnerability of the features to those effects.

The first and second of these elements relies on current understanding of the inherent sensitivity of features to particular factors, and the effect of operations on factors. Although there will be site specific elements to this information, it may often rely on information from a variety of sources which are not specific to this site. The third stage is very site-specific, relying on information about the types, location, intensity, duration and so on, of operations occurring or likely to occur in or around the site.

Given that in many cases, information of the type indicated in the previous paragraph is rudimentary, or simply not available a precautionary approach is adopted for the identification of factors and operations. This means that where there is uncertainty about the relevance or otherwise of a factor or operation, NRW favours including it in Regulation 37 advice. The output from this process is a list of operations that NRW considers may cause deterioration or disturbance to the features of the site, with accompanying information on the factors through which the each operation affects the feature. The operations advice clearly has to be based on the best available knowledge at the time and is subject to continual review. It necessarily involves an element of risk assessment, both in terms of assessing the likelihood of an operation or factor occurring, and the likelihood of it having an adverse effect on a feature.

NRW's advice to the relevant authorities is that, as a minimum, the extent and management of the operations identified in Section 6 should be reviewed in the context of the conservation objectives. The list should also help identify the types of plans or projects that would be likely to have a significant effect and should be subject to appropriate assessment, noting that such judgements will need to be made on a case-specific basis.

The advice in Section 6 of this document is not a list of prohibited operations, or operations necessarily requiring consultation with NRW, or NRW's consent[16]. The input of the relevant authorities and others is a legal and practical necessity in determining the management needs of the site. Thus, the operations advice is provided specifically with the intention of initiating dialogue between NRW and the relevant authorities.

[16] However, in relation to land included within the SAC, which has been notified as a Site of Special Scientific Interest (SSSI), owners or occupiers require NRW's consent for any operations included in the SSSI notification, and statutory bodies intending to carry out or permit potentially damaging operations must notify NRW and comply with certain other provisions. (Wildlife and Countryside Act 1981, section 28, as amended by the Countryside and Rights of Way Act 2000, section 75). General guidance on the operation of SSSIs is given in the CCW leaflet *Sites of Special Scientific Interest: A guide for landowners and occupiers* (Countryside Council for Wales, Bangor, 2001).

3. Site and Feature Description

3.1 Introduction

Cardigan Bay is one of the largest bays in the British Isles, measuring over 100km (60 miles) across its westernmost extent from the Lleyn Peninsula to St. David's Head.

A population of bottlenose dolphins forms a primary interest of the Bay and it was for this that the Bay was first selected as a Special Area of Conservation. Early surveys by Greenpeace and others in the 1990's identified the importance of the Bay for bottlenose dolphins. Other research since then, encouraged by the earlier work, has broadened our knowledge of the marine habitats of the bay as well as its more charismatic inhabitants.

Bottlenose dolphins range widely throughout UK waters and considerably further afield, but Cardigan Bay is one of the very few areas around the UK where significant numbers are known to occur regularly.

The *Cardigan Bay SAC* is a multiple interest site which has been selected for the presence of seven interest features that qualify under Annex I and Annex II of the Habitats Directive. For the qualifying habitats and species the SAC is considered to be one of the best areas in the UK for:

- *Tursiops truncatus* – bottlenose dolphin

and to support a significant presence of:

- Reefs
- Submerged or partially submerged sea caves
- Sandbanks which are slightly covered by seawater all the time
- Halichoerus grypus – grey seal
- Lampetra fluviatilis – river lamprey
- Petromyzon marinus – sea lamprey

The features are distributed throughout the SAC with no single feature occupying the entire SAC and with features overlapping in some locations. The SAC boundary and the general location of the Annex I habitat features are shown in the feature map[17]. These are indicative maps as the extent of most features is not known precisely and some, such as sandbanks, are dynamic and can be highly mobile. A number of habitats and species also have Biodiversity Action Plans or are on other lists specifying conservation action such as, 'Nationally Rare and Scarce Species'.

3.1.1 Sources and limitation of site information

All feature descriptions are based on best available knowledge at the present time and in some cases this is limited. Detailed information on the bathymetry within Cardigan Bay, for example, is quite poor. The distribution of submerged reefs is mainly derived from marine biological surveys and published bathymetric data, supplemented by a broad-scale

[17] The feature map can be found on the NRW website and information on the map features, data sources and any changes can be found in Annex I.

acoustic survey. Information that has been used to produce the feature maps for the site is detailed in Annex I.

Although we are building a good baseline on the Cardigan Bay bottlenose dolphin population, there are many aspects requiring further research. Assessing the abundance, health, reproduction and survival rates of such long-lived marine mammals is necessarily a long-term process. International collaboration is important to increase the understanding of cetacean distribution and abundance and interactions with dolphins from other areas. Collecting data from stranded animals provides valuable information on the occurrence and distribution of stranded dolphins and post-mortem analysis provides otherwise hard to obtain information on patterns of mortality, disease and diet. This is an important baseline for detecting unusual mortality events and the UK's Cetacean Strandings Investigation Programme continues to collect biological samples that provide insights into the life history characteristics and foraging ecology of the species.

Summary climate information is available from the UK Meteorological Office and Aberporth RAF and historical and current datasets are available from several local coastal stations however this frequently underrepresents the extremes (particularly wind strength) experienced around the west Pembrokeshire coast (Met Office, *pers comm*). New offshore wave buoy now installed, should assist with our understanding of wave climate in the future.

Our understanding of the reef feature boundaries has been improved by research carried out by Bangor University while researching scallop fishing impact in the bay.

3.2 Site Description

The Cardigan Bay SAC encompasses areas of sea and coast that support a wide range of different marine habitats and wildlife some of which are unique in Wales. Sites of Special Scientific Interest (SSSI) that are partly or wholly within the SAC or adjacent to the SAC are listed in Annex II and shown in the feature map[18].

All references to depths should be taken as Below Chart Datum (BCD) unless stated otherwise.

a) Range

The Cardigan Bay SAC is sited off the south Ceredigion and north Pembrokeshire coast, in the southern part of Cardigan Bay. The landward boundary runs along the coast from Aberarth to Ceibwr just south of the Teifi Estuary, typically following the back of the shore or the first hedge line beyond the top of the cliff or coastal slope. The boundary of the site was determined to encompass the features for which the site was selected, primarily what was regarded as the main area of importance for the bottlenose dolphins; it is not a representation of the precise extent of any one feature[19]. The site extends approximately twelve miles offshore and occupies approximately 960 square kilometres.

[18] The feature map can be found on the NRW website and information on the map features, data sources and any changes can be found in Annex I.

[19] "*As a general principle, site boundaries have been drawn closely around the qualifying habitat types or the habitats of species for which the sites have been selected, taking into account the need to ensure that the site operates as a functional whole for the conservation of the habitat type(s) or species and to maintain sensible management units.*" McLeod et al, 2002.

b) Structure

i. Geology

The geology of Cardigan Bay consists of an almost complete arc of Pre-Cambrian and Lower Palaeozoic rocks cradling a post-Palaeozoic sedimentary basin. It is oriented south-west to north-east extending from St. George's Channel to the coastline of Tremadoc Bay. The area was subject to periods of intense erosion during glaciations, at which time sediments were deposited, particularly in the Celtic Trough. Quaternary sediments completely cover Cardigan Bay except for small areas of exposed basement rocks, for example off Bardsey and the north Pembrokeshire coast.

Exposed boulders and bedrock mainly occur in regions dominated by strong tidal currents or wave action, such as headlands and the intertidal zone. The distribution and extent of the main intertidal rock types is well known, though the distribution and extent of subtidal rock types is incompletely known and largely inferred.

ii. Sedimentology

Cardigan Bay SAC supports an extremely wide range of sediments, from well sorted, highly homogenous sands to well mixed muddy gravels, pebbles and cobble. The stable seabed in the western part of the SAC is largely sandy and gravely with occasional areas of mega ripples. The eastern and inshore areas are more variable, constituting mixed ground with areas of sand, mud, muddy gravels, pebble, cobble and boulder. The coastal areas are generally dominated by sands, but with some intrusions of gravel such as the area adjacent to New Quay.

iii Geomorphology

Cardigan Bay is a relatively shallow and gently sloping embayment of the Irish Sea, generally reaching 50 m only in the outer parts of the bay towards St. George's Channel. Most of the SAC is less than 30 m deep, with deeper areas off Aberporth and in the south western part of the site. Due to the general shallowness, wind and wave action dominate the physical processes. The seabed is relatively level with gentle banks and troughs but there are areas of greater topographical interest, particularly closer to shore and in the vicinity of headlands.

The coast is dominated by rugged headlands, interspersed by bays and the Teifi inlet. Shores tend to become more rugged and rocky towards the southern end of the site, typically with sandy bays. Towards the north the headlands consist of softer rocks and the shores tend to be dominated by cobble, pebble and boulders. The geomorphology of this area is described in more detail within the West of Wales Shoreline Management Plan[20].

c) Function

i. Hydrography and meterology

The Irish Sea is a relatively enclosed body of water with moderate tidal ranges. In the southern part of Cardigan Bay, for example, mean spring tidal ranges are approximately 4-5 m. Tides in this area are predominantly semi-diurnal, with high and low water times getting progressively later further north. The tide enters the bay via St. George's Channel with a weak average flow northwards of both surface and bottom currents, running north during flood tides and south during the ebb.

[20] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/)

Tidal currents are generally low within the bay (max 0.9 m/s) but locally variable, and little is known about water transport patterns. The weakest tidal currents are within Tremadoc Bay, increasing to the south and west. Currents are slightly stronger near headlands and estuaries with some of the strongest currents along the SAC coast run between Cardigan Island and the mainland.

The bay has a mainly open coastline, exposed to the prevailing south-westerly and westerly winds however as the Irish Sea is relatively sheltered, the majority of waves reaching the Cardigan Bay coast are locally generated, of fairly short period and therefore steep. A substantial swell develops during prolonged periods of high winds. During the winter when gales are common, the wave height exceeds 1 m for about half the time, compared to about a quarter of the time during the summer months. Depending on the wind direction, small embayments within the SAC may provide some shelter during stormy conditions in the areas of New Quay, Ynys Lochtyn, Aberporth, Mwnt and the Teifi estuary. The water masses are partly of coastal origin (Bristol Channel and southern Irish Sea circulation) with an oceanic input through the Celtic Sea. The general pattern of near-surface water movement in the Irish and Celtic Seas and south-western approaches indicates the possibility of a certain amount of water recirculation; this is of significance for larvae and spore dispersal. Water circulation is seasonally modified as a result of summer heating and stratification (density layering) in the Celtic and Irish Seas.

Parts of the Irish Sea have a marked seasonal variation in turbidity and this is particularly true in Cardigan Bay. During the summer suspended sediments settle out in the relatively calm bay whereas during the winter when winds increase, bottom sediments are mixed throughout the water column and produce turbid surface waters, particularly close to the coast. Turbidity of inshore waters is also strongly affected by outflow from the rivers such as the Aeron, Ina, and Teifi, as well as smaller outflows. Sediments from the Gwaun and Nevern Rivers adjacent to the southern boundary of the site are also carried into the SAC by tidal currents, and together these turbid waters often form darker coloured bands that spread out from the estuaries and follow the line of the coast. Seasonal phytoplankton blooms temporarily increase particulate concentrations and decrease water clarity.

ii. Water & sediment chemistry

Salinity within Cardigan Bay is influenced not only by incoming Atlantic water, but also by freshwater input from rainfall, run-off from rivers and estuaries within the bay as well as the Severn, and the effects of evaporation, currents and mixing. Surface salinities within the Bay in summer are generally less than 34‰, decreasing towards the shore. During the summer months when the inshore waters of Cardigan Bay are stratified, salinity also varies with depth with fresher water overlying more saline water, particularly near the mouths of rivers and estuaries. Rainfall into the Irish Sea contributes a volume of water equal to about one third of the riverine input. Cardigan Bay receives an average freshwater flow from rivers of 113 m^3s^{-1} with rivers adjacent to the SAC including the Aeron, Ina and Teifi, contributing the greatest input of freshwater into the SAC. Smaller streams and freshwater from the rivers Nevern at Newport and the Gwaun at Fishguard also affect salinity, particularly in the southern inshore waters of the SAC. River discharges are highly variable and the largest inputs to Cardigan Bay occur between December and February and the smallest in July.

The limited marine monitoring undertaken in Cardigan Bay has found the water quality to be good however sediment analysis has found significant levels of contaminants at several

locations in the bay. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales[21].

iii Sediment processes

Detailed sediment processes in St George's Channel are poorly known but inferred to be dominated by tidal current action on mainly coarse, relict or locally derived strong currents have prevented the accumulation of fine sediment. Long period wave action also has a major local modifying effect. There is a net westward transport of sediments from the Bristol Channel across and into southern Irish Sea. The sand fraction is transported near-bed and the muddier fractions in suspension, possibly resulting in different transport paths. The presence of major sandy bed-forms (well south of Cardigan Bay SAC) indicates the transport of large volumes of material. Shoreline and near shore sediment process have been studied in more detail and are described within the West of Wales Shoreline Management Plan[22].

iv Biological interactions

Species interactions within the SAC are complex and inter-related. Bottlenose dolphin and grey seal, for example, are top predators and therefore are likely to be affected by changes at lower trophic levels in the food chain. These food chains extend beyond the confines of Cardigan Bay SAC, as both the dolphins and seals rely heavily on prey that spend much of their time outside the site and which, in turn, may interact with species populations some distance away. Impacts on biological interactions taking place some distance from the site may can therefore have a significant effect on these predators.

d) Typical species

Current biological survey data provides limited indicative information on the distribution (range) of some species within the site, particularly the most widely distributed and frequent. However, the spatial and temporal resolution of the data is insufficient to show precise distribution or temporal variation in distribution.

3.2 Operations within the SAC

Human activity within Cardigan Bay is relatively light and forms a backdrop to dominant natural forces. The shoreline, backed by agricultural land, is little developed with shoreline activities greatest in the summer months when the small villages, caravan and camping sites become busy with an influx of tourists. Industry is light and limited largely to the fishing sector. Static gear such as pots and set nets predominate, and are focussed close to shore. Scallop fishing is currently contained in one part of the site[23] and has been assessed through a Habitats Regulation Assessment.

Shipping passes by far out to sea and the inshore waters are generally quiet except for the summer months when recreational boaters and tourist boat trips (in particular wildlife tours) are busy along the coast adding to the seasonal increase in fishing activity.

[21] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Cardigan Bay central & Cardigan Bay north.
[22] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/)
[23] The Scallop Fishing (Wales) Order 2010 (http://www.legislation.gov.uk/wsi/2010/269/contents/made)

3.4 Modifications as a result of human activity

Various anthropogenic activities currently taking place within the SAC have an influence on the habitat and species features. Section 6 provides additional information on the ways in which such activities might affect the features. Some of the activities will have a direct effect whilst others will have an indirect effect, by altering or modifying the physical, chemical and environmental factors and processes (structural and functional characteristics) which affect the habitats and species. Whilst the structural and functional characteristics of the SAC and its habitat features are inherently important attributes of the marine ecosystem, it is the effect that these characteristics have on the wildlife of the SAC that is of conservation importance.

The abundance and range of bottlenose dolphins has declined over the past few centuries as a consequence of human activities. Current human activities impact upon the bottlenose dolphins, such as disturbance (recreational and tourist trip boats), pollution (particularly organohalides), prey depletion (fisheries) and fisheries activities. These can directly or indirectly cause deaths, affect survivorship or reduce reproductive potential. The degree to which these damaging influences are currently significant in terms of site population maintenance is not known.

The limited marine monitoring undertaken in Cardigan Bay has found the water quality to be good. However, sediment analysis has found significant levels of contaminants at several locations within the bay, typically associated with small harbours such as those at Aberystwyth, Aberaeron and New Quay. These have included raised levels of Tributyl Tin (TBT), Polychlorinated Biphenyls (PCBs) and metals such as lead, copper and zinc. Furthermore, analysis of tissue samples from stranded marine mammals in the area show raised levels of heavy metals, mercury and organo-halide compounds. Fish in Cardigan Bay have been recorded with some of the highest prevalence of liver cancer in UK waters. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales[24].

The majority of the consented discharges to the SAC are of domestic sewage effluent with a few being from an industrial source. However, diffuse run off and effluent from agricultural land and the continuing impact from historic mining activity (metals) provide the major landward inputs in central Cardigan Bay. The scale and significance of contaminant input from outside the site, via the movement of marine waters and sediments or the movement of marine organisms (e.g. dolphin prey), is not known.

Species subject to commercial fisheries exploitation are known, or inferred, to be depleted below preexploitation levels, some very significantly. Impacts of non-target species bycatch and consequential physical impacts of demersal gear are well documented. Scientific evidence suggests that aspects of ecosystem functioning will have been modified as a consequence. Cardigan Bay has a history of fishery boom and bust, and some species once forming an important industry in the area (e.g. Herring) are now hardly fished at all as a result of wide-spread over exploitation. Strong links exist between fishing and marine mammal features of the SAC when considering predator/prey interactions and changes have undoubtedly taken place as a result of man's activity with possible

[24] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Cardigan Bay central & Cardigan Bay north.

implications for other wildlife including the status of the two marine mammal species for which the site has been designated

An assessment of the conservation status of each of the habitat features, at a UK level, was first reported in 2001, again in 2007 and most recently in 2013[25].

4. Feature Descriptions

4.1 Bottlenose dolphin (*Tursiops truncatus*)

Bottlenose dolphins (*Tursiops truncatus)* are a cosmopolitan species, widely distributed in a range of mainly nearshore coastal habitats from tropical to temperate seas, in sheltered and exposed areas of estuaries, lagoons, continental coasts – a coastal ecotype, and also in pelagic waters offshore and around oceanic island coasts – an offshore ecotype. In Britain, bottlenose dolphins have been recorded most frequently in coastal waters, predominantly in two areas: Cardigan Bay and the Moray Firth. Small groups have been recorded regularly elsewhere including along the Cornish, Devon and Dorset coasts, in the waters around the Hebrides, off the Irish coast particularly in the Shannon Estuary, and frequently in offshore waters of the North-east Atlantic, Irish Sea and St. George's Channel.

Dolphins from all of these areas may occasionally move some distance from their apparent core range. For example, regular sightings in the Firth of Forth probably involve dolphins from the Moray Firth and sightings in North Wales involve Cardigan Bay dolphins. Other dolphin groups, presumed to be transients, are recorded further offshore in deeper water in the Celtic Deep and to the west of Scotland.

The total population of coastal bottlenose dolphins in UK inshore waters is small[26] (estimates less than 500 individuals) and for offshore bottlenose dolphins abundance estimates from the SCANS II survey were 5,370 for the offshore Celtic Sea area and 12,643 in total for the European Atlantic continental shelf[27]. The species was formerly more widespread, particularly of coastal dolphin groups, especially in the southern North Sea and English Channel and has declined in range.

4.1.1 Population dynamics

Bottlenose dolphins are seen year-round in Cardigan Bay. The number of individuals increases during the summer months, as does group size reaching a peak in late September and October when quite large aggregations of more than 60 individuals may be seen. The dolphins are reported less frequently and in fewer numbers during the winter months, but this may partially be a reflection of poorer weather conditions and fewer observers watching the coast. Aerial surveys in Cardigan Bay in winter 2007 showed a clear preference for the offshore areas of the bay.

In the early 1990's there were estimated to be about 130 bottlenose dolphins in Cardigan Bay. More recent estimates also indicate a relatively small number of individuals, between

[25] Joint Nature Conservation Committee. 2013. General Implementation Report - 3rd UK Habitats Directive Reporting 2013. Available from: http://jncc.defra.gov.uk/page-6387
[26] Reid *et al*. (2003)
[27] Hammond & Macleod, (2006)

100 - 300. Intensive research of the Cardigan Bay dolphin population started in 2001 using photo-identification and line transects[28]. Most of the individuals identified during studies have been seen more than once, and a number of these animals have also been recorded in more than one year. Some dolphins have been identified in the Bay every year for periods of five years and more, while others appear to return to the area after a gap of one or two years. There appears to have been an overall increase in population size between 2001-2007 and a decline since then to 2001 levels but there is considerable variability between years and low confidence in some estimates (and the apparent trends are not significant). The decline in recent years may be related to animals moving away from the study area.

Bottlenose dolphins are highly social animals with group sizes varying seasonally. Although occasionally found alone, they are more often found in groups of anything from a few individuals up to several hundred; the larger aggregations are seen more often in exposed, open coastline or offshore waters (and usually represent the offshore ecotype) rather than sheltered habitats close inshore where coastal bottlenose dolphins are present in small groups.

They are a long-lived species that may survive in the wild for 40-50 years or more. Males commonly have a shorter lifespan of 25-35 years, while females are known to have lived over 50 years. The reproductive rate of bottlenose dolphins is low. Females produce a single calf every 2-6 years, following a gestation period of about one year, and the pregnancy rate does not appear to decrease with age. The timing of birth varies greatly and is likely to be influenced by many interacting factors.

Calving periods are probably timed to take advantage of seasons when food is particularly abundant. Calving is known to have taken place within Cardigan Bay and new-born and very young calves have been reported in Cardigan Bay from April to September, suggesting a seasonal pattern to calving. There is a likely preference for more sheltered shallow areas for calving. Reproductive rates in Cardigan Bay SAC present healthy crude birth rates of 5.3% and 7.8% using closed and open population models respectively, confirming that this region serves as an important nursery ground for females and their young calves. Birth rates calculated for the entire Bay are even higher, especially when using an open population model (9.4%), suggesting there are additional females nursing their young within other areas of the Bay including Pen Llŷn a'r Sarnau SAC[29].

Calf mortality rates calculated for Cardigan Bay SAC are 18% for each of the first and second years, decreasing to 8% in the third year; a total of 55% of calves survive into their fourth year, when they reach independence from their mother.

Recent analysis shows that nearly 30% of individuals have been identified in both Cardigan Bay SAC and Pen Llŷn a'r Sarnau SAC as well as north of the Llŷn Peninsula around the Isle of Anglesey, indicating large home ranges that most probably extend to the northern Irish Sea and maybe beyond. However, a proportion of the population shows a more local residency pattern, with relatively small home ranges.

Surveys show that the numbers of bottlenose dolphins are greatest between July and October and only a few animals are seen between November and April, although some

[28] Feingold & Evans (2013)
[29] Feingold & Evans (2013)

animals are present near shore in every month of the year. They are most commonly seen within 10 miles of the coast, from April to October and most concentrated within 2 miles near headlands, estuaries and in embayments.

Most of the dolphins identified in Cardigan Bay have markings, lesions or injuries on their skin. This is common in bottlenose dolphins world-wide, and the severity in Cardigan Bay is about average in comparison with other populations. One study found that temperature and salinity have had a more significant effect on skin condition than pollution.

A range of viral, bacterial and parasitic diseases are known to be endemic within bottlenose dolphin populations but have a limited effect on healthy, unstressed adult animals. Bottlenose dolphins are susceptible to certain diseases of domestic animals such as brucellosis and morbilliviruses.

Pollution is a potential threat to the health of the Cardigan Bay dolphins and their environment. In a recent study, 15 stranded bottlenose dolphins were found to have levels of PCBs over 80mg/kg, which is well over the 17mg/kg threshold for adverse reproductive effects, and was considered to be of concern, especially as this is a long-lived apex predator of relatively small population size that only reproduces every 2-6 years.

4.1.2 Range

The dolphins of Cardigan Bay SAC represent a mobile and wide-ranging population of variable individual residence. Their full range is not known but individuals recorded regularly along the southern coast of the Bay have also been seen both north and south of the SAC. Species range varies from year to year and this variation is likely to be predominantly as a consequence of natural environmental changes such as prey distribution.

Bottlenose dolphins have been seen all round the Welsh coast since the early part of this century, but mainly throughout Cardigan Bay where they are reported most frequently inshore from about Aberystwyth to the Teifi Estuary. Along this southern coastline, dolphins are often sighted within the SAC off headlands and in more sheltered areas near New Quay, Ynys Lochtyn, Aberporth, Mwnt, and the Teifi Estuary. It should be noted that the coast between New Quay and Cemaes Head has been the area of greatest observer effort over the years.

The dolphins of the Cardigan Bay are highly mobile. Surveys in North Wales (particularly from Anglesey eastwards towards Liverpool Bay) during 2007-08 have revealed that some individuals spend at least part of the winter in this area. Even in summer, there are bottlenose dolphins regularly using the waters around North Wales northwards to at least the Isle of Man and Cumbrian coast.

Strandings data indicate that some large changes have occurred for this species in UK waters. From 1948 to 1966 bottlenose dolphin strandings occurred in relative large numbers on north western British coasts, around the Irish Sea and in the south east along the English Channel to East Anglia. Since 1990 most strandings have occurred in West Wales and the Moray Firth reflecting the resident populations concentrated in those regions. The numbers of animals stranding have declined. In the 1940s through to 1960s this species was the second to third most commonly stranded. Over the last 15 years their ranking has dropped to 10th or 11th.

4.1.3 Supporting habitat and species

The precise habitat requirements of bottlenose dolphins are poorly understood, but includes habitat that is of sufficient quality for feeding and calving, as well as resting and travelling. The Cardigan Bay SAC provides a proportion of the overall habitat requirements of the bottlenose dolphins that occur within the site, with different areas being used throughout the site. In coastal waters they appear to favour habitat with uneven topography and/or strong tidal currents and acoustic monitoring has demonstrated the importance of sandbanks and reefs for foraging. The high frequency of sightings along the coast from Aberaeron to Cardigan and around Fishguard suggests these areas may be of particular significance.

The animals make regular use of areas with strong tidal currents, especially near headlands, and behaviour interpreted as feeding has been observed and reported. There are also observations of bottlenose dolphin aggregations in the SAC at the entrances to estuaries. Salmonids are concentrated in estuary mouths during settled weather awaiting rising river levels to make their way upstream indicating that the catchments of freshwater tributaries entering the site contribute to the overall site integrity for this species.

Bottlenose dolphins are generalist and opportunistic feeders eating a wide range of pelagic and benthic (demersal) fish, crustaceans and molluscs. Prey species include haddock *Melanogrammus aeglefinus*, saithe *Pollachius virens*, cod *Gadus morhua*, hake *Merluccius merluccius*, mullet *Mugil* spp., eels *Anguilla anguilla* and *Conger conger*, salmon *Salmo salar*, trout *Salmo trutta*, bass *Dicentrarchus labrax* and sand eels Ammodytidae, as well as octopus *Eledone cirrhosa*, *Loligo* spp., and other cephalopods. The only natural predator, the killer whale *Orcinas orca* is infrequently sighted in Cardigan Bay.

From visual observations of the surface behaviour of bottlenose dolphins in Cardigan Bay, it is known that they capture pelagic fish such as sea trout (sewin), salmon, bass, mullet, mackerel, and garfish. There is limited knowledge of the degree to which the species preys upon demersal fish or benthic invertebrates. A post-mortem examination of a bottlenose dolphin in North Wales indicated stomach content was dominated by flatfish and interestingly the cause of death was associated with a dab obstructing the blowhole. Several studies have related visual and acoustic behavioural observations to foraging activities and have indicated the importance of sandbank and reef habitats.

As bottlenose dolphins forage widely, a decline in prey species in one area may not immediately impact the population. The status of likely prey species and the degree to which the bottlenose dolphin population is limited by prey availability is generally unknown. Prey availability is likely to be a key factor in determining the abundance and distribution of dolphins in Cardigan Bay.

Feeding activities have been recorded throughout the inshore waters of the Bay, with the distribution and movement of prey believed to influence the distribution and movement patterns of cetaceans.

4.1.4 Modifications as a result of human activity

The population of bottlenose dolphin in the SAC is small, though stable and the resilience of the population to change is unknown. There are various potential human causes for inhibition of calf production and survival, *e.g.* pollutant burdens or modification of prey

availability, but there is no evidence to suggest calf production is currently significantly modified by human action. There is also no contemporary evidence to suggest age frequency or sex ratio is being modified by human action.

Data on persistent pollutants burdens is known from limited post-mortem examinations of bottlenose dolphins from within the site and further afield; the limited post mortem data shows tissue levels of persistent pollutants are of concern, although their direct population effects or effects on the site are currently unknown.

The effects of persistent pollutants burdens or modified food resources on health or reproductive capability have not been investigated within the site and any modification caused by burdens of persistent pollutants or modified food resources is unknown. However, contaminants are present within dolphin food chains, including those that are persistent and those that tend to bioaccumulate and biomagnify. Lipophyllic contaminants such as organohalides (e.g. polychlorinated biphenyls) are of particular concern, as they tend to accumulate within fatty tissue and are remobilised during lactation.

The presence of artificial inert or toxic materials, e.g. synthetic plastics and fibres, hydrocarbons, can cause entanglement and incidental capture. There is little evidence to suggest that entanglement in fishing gear or the ingestion of marine debris is a particular problem in Cardigan Bay.

The degree to which range is being affected by change to prey stocks and human disturbance is not known. There has been a decline in commercial fish stocks over the last two centuries, and particularly in the last 50 years. The majority of commercial fish populations assessed in the Irish Sea are currently recorded as being outside safe biological limits.

Disturbance by human activity may occur within close proximity to the dolphins or at some distance, for example through use of underwater sonar equipment that has the potential to disturb cetaceans, although this has not be demonstrated for bottlenose dolphins.

There is a continual increase in the number of power craft of all sizes operating within the SAC and Cardigan Bay as a whole. Bottlenose dolphins in Cardigan Bay were observed to respond to approaching boats at a distance of 150-300 metres by making longer dives and moving away from the source of the sound in a study using recordings of underwater sound. Although relatively quiet in terms of underwater noise, fast manoeuvrable craft such as jet skis were considered to have the potential to startle dolphins with their sudden approach. Elsewhere changes in habitat use and avoidance of previously preferred areas have been associated with increase in boat traffic. Commercial wildlife watching activities has increased in recent years. Separation distances between bottlenose dolphins and passenger boats carrying visitors were significantly greater after the introduction of a boat operator's code of conduct. A study in 2012 examined the effect of boat disturbance on the social structure of bottlenose dolphins in Cardigan Bay. The results indicated that vessel traffic does impact community structure[30].

Boat collision is a potential risk, there are no records of bottlenose dolphins being killed by boats but propeller injuries have been noted in Cardigan Bay on one female and

[30] Feingold & Evans (2013)

suspected in a young calf. The injury to the female, which is thought to have occurred in 2007, did not seem to impact on her mobility or reproduction as she has since been identified from different locations across the Bay, off Anglesey and the Isle of Man and was later identified with a calf[31].

4.2 Grey Seal (*Halichoerus grypus*)

The UK population of grey seals (*Halichoerus grypus* Fabricius, 1791) represents about 38% of the world population and 83% of the EU population. The total UK grey seal population size in 2012 was estimated as 112,300 (95% CI: 90,600-142,900)[32]. Based on pup production estimates, the Welsh 'population' forms around 3.3% of the UK or about 2.7% of the European population.

The breeding ecology differs from that of grey seals elsewhere in the British Isles as the seals here tend to use secluded coves and caves for pupping instead of forming large congregations of pupping females on open sites[33]. While most of the important pupping beaches, caves and haul-out sites occur in Pembrokeshire, grey seals are known to range throughout Cardigan Bay and North Wales and there are a significant number of pupping sites in south-western Ceredigion.

4.2.1 Population dynamics

Grey seals present within the site at any one time do not form a discrete population, but are centred (in terms of abundance) on Cardigan Bay and are considered part of the SW England and Wales management unit[34]. This population itself is not isolated but extends from SW Scotland to SW England and SE Ireland (individuals have been photographically recaptured among these regions[35] and there are movements and exchanges with more distant populations (satellite tracked individuals have been tracked to/from France, west coast of Scotland and Ireland[36]).

Pup production can be used as an index of seal population size, if age structure is stable and where rate of change is constant, or where alternative information on fecundity or survival rates is available[37]. UK grey seal population size is estimated from pup counts using a complex population dynamics, Bayesian state-space model[38]. The south-west Wales 'population' size is also determined from pup counts, and has been estimated at approximately 5000 individuals[39]. Pup production within the Cardigan Bay site represents a small proportion of the south-west Wales production. Most long-term survey data has been collected from small parts of the Pembrokeshire Marine SAC - namely Skomer Island and Marloes Peninsula with annual data from the 1970's[40], and less frequent data from the North Pembrokeshire coast and Ramsey Island[41] - with trends for the south-west Wales population inferred from this data.

[31] Feingold & Evans (2013)
[32] SCOS (2013)
[33] Baines *et al.* (1995); Stringell *et al.* (2013)
[34] IAMMWG, (2013).
[35] Keily *et al*. (2000), SCOS (2013), Cornwall Seal Group *pers. comm*., NRW Unpublished data
[36] Cronin (2011), Vincent, unpublished data
[37] Duck & Thompson, (2007)
[38] SCOS, 2013
[39] Baines *et al*. (1995)
[40] Newman *et al*. (2015)
[41] Strong *et al*. (2006)

The population is not known to be subject to predation although potential predators such as killer whales and large sharks are occasionally recorded within the Irish Sea.

In terms of reproductive success pupping numbers diminish rapidly from the Teifi estuary northwards, with Cemaes being of greatest importance, although pups are also born near Lochtyn, Aberporth and Cardigan. The average number of pups born within the Cardigan Bay SAC between 1992-94 was 66 pups per year representing approx. 1.7% of the total recorded pups born within West Wales. Data from Pembrokeshire in 2015 recorded combined survival of 77.8% of pup survival to moulting[42] which is above the long-term UK national average. There is currently insufficient data for Cardigan Bay SAC to ascertain within-site pup survival.

The age frequency and sex ratio of the population is unknown as are fundamental population demographics such as female fecundity, adult survival / mortality and physiological health. An emerging phenomenon is the appearance of mortal spiral wounds thought to be caused by sudden traumatic events involving the strong rotational shearing force of a rotating blade. These injuries are consistent with the seals being drawn through a ducted propeller[43]. The occurrence of 'corkscrew' injuries is a growing concern in the UK and such occurrences have recently been reported in Wales[44]. A range of viral, bacterial and parasitic diseases are known to be endemic within seal populations but appear to have limited effect on healthy, unstressed, adult seals.

4.2.2 Range

Grey seals are highly mobile species[45], which can travel great distances[46]. There is an increasing need to understand the movement and connectivity of seals identified in SACs to inform conservation planning. Tracking studies can provide powerful insights into animal ecology and usually involves transmitting/recording devices, e.g. satellite telemetry, and/or tagging, e.g. flipper tags, branding or photo-identification. Photo-identification of seals offers the chance to photographically capture permanent and identifiable patterns on the pelage[47] of many animals at repeated times and low cost. Over 3000 individual seals have been photographed throughout Wales over the last two decades (NRW *unpubl data*) and photographically recaptured at multiple distant sites.

Seals are widely distributed within (and travel beyond) the site. A small number make long foraging trips offshore and up the Irish Sea to deeper waters. Only their pupping and regular moulting sites may be determined with precision and these are found throughout the site. Pupping is greatest towards the south-western end of the SAC and takes place throughout the site on open coast in suitable habitat (*i.e.* physically accessible, remote and/or undisturbed rocky coast beaches, coves and caves) and the high proportion of use of sea-caves by the south-west Wales population is a particularly unusual variation in breeding behaviour[48]. Moulting and resting haul-out sites are scattered along the site. None are used as haul-outs by large numbers of seals, instead they generally haul-out singly or in small groups in undisturbed locations throughout the site.

[42] Newman *et al*. (2015)
[43] Bexton *et al*. (2012), Thompson *et al*. (2013)
[44] Penrose *pers. comm.*
[45] Russell *et al*. (2013)
[46] e.g. >700km, Cronin (2011), Vincent *unpubl data*
[47] Hiby *et al*. (2013)
[48] see Stringell *et al*. (2013)

4.2.3 Habitat and species

The exact habitat requirements of grey seals is not known (seemingly suitable habitat is often not occupied) but must include suitable feeding, pupping, moulting and resting haul-out areas. They are assumed to feed throughout the site and they also travel some distance from the site to forage. Preferred pupping habitat tend to be secluded sites, sheltered from heavy wave action and accessible by females at all states of the tide. Pupping tends to occur at a limited number of favourable sites (mostly towards the south-western end of the SAC) with some use of less optimal sites. Moulting / resting haul-out habitat requirements are not known precisely but suitable habitat is extensive throughout the southern part of the site and is assumed to be adequate.

The structure of pupping beaches and caves, moulting and resting haul-out sites and feeding vary throughout the site, and the associated functional processes, are almost entirely determined by inherent coastal geomorphology and hydrography.

Grey seals are generalist feeders, foraging mainly on the sea bed, taking a wide variety of prey including sandeels, gadoids (cod, whiting, haddock, ling), and flatfish (plaice, sole, flounder, dab)[49]. Among these, sandeels are typically the predominant prey species, but diet varies seasonally and from region to region. A study of grey seal diets from scats collected in Pembrokeshire[50], found that gadoids (mainly whiting) and flatfish (mainly sole) dominated the diet (70% by weight).

4.2.4 Modifications as a result of human activity

Grey seals were historically subject to human exploitation[51]. Although large numbers were killed and taken until early in the twentieth century there is no reliable contemporaneous information on population size at that time, or of likely pre-exploitation numbers. There are occasional, often unattributable, anecdotal reports of seals being shot or accidentally captured and drowned in fishing gear[52], the magnitude or importance of such deaths to population dynamics are unknown but unlikely to have a population level effect.

There is no known evidence that human influences have contributed to the reduction / stabilisation of pup production[53]. Although increased disturbance or suppression of physiological health from various anthropogenic activities remains a possibility.

Artificially introduced hazards and reductions in the natural quality and suitability of grey seal habitat include: the presence and persistence of artificial inert or toxic materials, contamination of prey, disturbance and displacement due to noise and visual disturbance and competition with human activities for space, boat collision, noise and visual disturbance resulting in increased density dependent pressure on preferred sites

The effects of persistent pollutants burdens or modified food resources on health or reproductive capability have not been investigated within the site and any modification caused by burdens of persistent pollutants or modified food resources is unknown. The extremely limited post-mortem data available does not suggest that the physiological health of grey seals in this part of the UK is being adversely affected by any specific

[49] Brown *et al*. (2012), SCOS (2013).
[50] Strong (1996)
[51] Haug *et al*. (2007)
[52] SCOS (2013)
[53] Thompson & Härkönen (2008)

pollutants or diseases. A range of viral, bacterial and parasitic diseases are known to be endemic within seal populations but appear to have limited effect on healthy, unstressed, adult seals.

Minor and temporary modifications of distribution are routinely caused by various coastal and maritime human activities. The inaccessibility and predominantly winter use of moulting haul-out sites minimizes their exposure to human disturbance. However, anecdotal reports and observations suggest that seals maybe becoming increasingly habituated to human presence at certain sites.

4.3 River Lamprey (*Lampetra fluviatilis*) and Sea Lamprey (*Petromyzon marinus*)

Lampreys are primitive vertebrates that have a distinctive suckered mouth, rather than jaws. The river lamprey *Lampetra fluviatilis* is found only in Western Europe, where it has a wide distribution. The sea lamprey *Petromyzon marinus* occurs over much of the Atlantic coastal area of western and northern Europe and eastern North America where it is found in estuaries and easily accessible rivers.

Both species are widespread in the UK. Eggs are laid by the adults in clean river gravels. The larvae (ammocoetes) spend several years buried in sandy sediment in rivers feeding on organic matter before metamorphosing after 3-4 years. Juveniles migrate to estuaries and inshore waters where they feed parasitically on various fish species. Once fully grown, they migrate upstream to spawn. After spawning, the adults die.

During their marine phase, river lampreys are predominantly an estuarine and inshore species feeding on small fish such as herrings and sprats. Sea lampreys are much larger and more oceanic, feeding initially on similar species to river lampreys before switching to larger prey, including sharks and cetaceans[54]. Juvenile sea lampreys have been suggested to prefer migratory species (including shad) as prey in freshwater and estuarine environments, perhaps due to their larger size[55]. At sea they appear not to be very selective and have been recorded feeding on at least 54 different species. Sea lampreys have been recorded 400km or more from the nearest land[56] and at depths of up to 1000m.

4.3.1 Population dynamics

River and sea lampreys are difficult to sample in the marine environment. Inferences about the status of the river lamprey population in the Cardigan Bay SAC are based on condition monitoring of the Afon Teifi SAC, which assesses the extent and density of juvenile lampreys.

Lampreys do not home to their natal river[57], so lampreys using the Cardigan Bay SAC should be viewed as a protected component of a larger population covering the Bristol Channel and possibly a wider area. In particular, the river and sea lamprey populations of the River Wye, River Usk, Afon Tywi, Afon Teifi, Afonydd Cleddau, Carmarthen Bay & Estuaries and Pembrokeshire Marine should be seen as linked to Cardigan Bay SAC.

[54] Silva *et al*. (2014)
[55] Silva et al. (2013)
[56] Kelly & King (2001)
[57] Bergstedt & Seelye (1995)

Lampreys use the site as an access corridor between the open sea and riverine breeding habitat. The numbers of individuals within the site at any time, and their distributions and proportions of wider populations, are likely to be dynamic and are unknown. Presence is inferred to be highly seasonal.

4.3.2 Range

Adult river lampreys migrate through the SAC to reach the Afon Teifi and River Aeron on their spawning migration, entering freshwater between October and December[58]. Juvenile river lampreys generally migrate downstream into estuaries and inshore waters in spring, though autumn migrations have also been recorded. Since river lampreys feed and grow in estuaries and inshore waters, it should be assumed that juveniles are present in the SAC throughout the year.

Adult sea lampreys migrate through the site between March and June to reach the Afon Teifi and River Aeron. Lampreys from the Rivers Usk, Wye and Teifi may use the inshore waters of the SAC. Mature adults enter the estuaries from April onwards and migrate some distance upstream. Peak migration usually coincides with temperatures that remain above 10^{o}C and continues until temperatures reach 18^{o}C. Juvenile sea lampreys migrate downstream between December and June[59] and spend some time feeding in the estuary and inshore waters before moving off shore in search of larger prey. Accordingly, various stages of sea lamprey should be assumed to be present all year round.

4.3.3 Habitats and species

River lampreys feed on a variety of estuarine and coastal fish, but particularly herring, sprat and flounder. The adults feed on much the same species in both estuaries and coastal waters. Sprats are likely to be abundant during the winter in Cardigan Bay and flounders are also common and therefore these are likely to be a primary food source.

Sea lamprey feed on a wide range of fish, shark and cetacean species. Prey selection is thought to be size rather than taxon-specific and is positively correlated with lamprey size. They are not thought to be restricted to any specific habitat and are likely to follow prey: however a preference for demersal species and sheltered locations has been suggested[60].

4.3.4 Modifications as a result of human activity

Very little is known about impacts of human activity on these species in this site. For example there is no known information on historical or contemporary by-catch within the site, and no known evidence of incidental capture. The absence of known by-catch records suggests a low direct risk from fisheries. There is also no known evidence that shad and lamprey habitat structure is inadequate. Water column contaminants are a threat to physiological health, but water quality is assumed to be sufficiently high in open coastal waters. Water quality obstacles within adjacent river catchments are unknown. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales[61].

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[58] Maitland (2003)
[59] Silva *et al*. (2013) summarised the data and found that it varies with increasing latitude: the Irish chronology has been used as being most likely to be similar to the Tywi.
[60] Silva *et al*. (2014)
[61] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Cardigan Bay central & Cardigan Bay north.

There are no known or likely physical impediments to access within or transit though the site, though there are within the adjacent rivers (e.g. weirs).The presence and persistence of artificial inert materials (*e.g.* plastics and synthetic fibres) creates an entanglement risk within the site.

4.4 Reefs

Reefs are widespread in northern and southern Europe and occur widely around the UK coast. They are defined in the EU Interpretation Manual[62] as:

"either biogenic concretions or of geogenic origin. They are hard compact substrata on solid and soft bottoms, which arise from the sea floor in the sublittoral and littoral zone. Reefs may support a zonation of benthic communities of algae and animal species as well as concretions and corallogenic concretions."

Rocky reefs are extremely variable, both in structure and in the communities they support. They range from vertical rock walls to horizontal ledges, sloping or flat bedrock, broken rock, boulder fields, and aggregations of cobbles. Reefs are characterised by communities of attached algae and invertebrates, usually with a range of associated mobile animals. Algae tend to dominate the more illuminated shallow water and intertidal areas and animals the darker deeper areas. The specific communities vary according to a variety of factors such as, rock type, wave exposure, slope, aspect, and tidal streams.

There is less variation in biogenic reefs, but the associated communities can vary according to local conditions of water movement, salinity, depth and turbidity. The main species which form biogenic reefs in the UK are blue mussels *Mytilus edulis*, horse mussels *Modiolus modiolus*, ross worms *Sabellaria* spp., the serpulid worm *Serpula vermicularis*, and cold-water corals such as *Lophelia pertusa*.

There are several habitats and species of conservation importance (Environment (Wales) Act Section 7 and OSPAR threatened and declining habitats and species) that occur within this habitat. These are:

- Estuarine rocky habitats
- Intertidal Underboulder Communities
- Mussel beds
- Sabellaria alveolata reef
- Blue mussel beds
- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Subtidal mixed muddy sediments
- *Arctica islandica*
- *Ostrea edulis*
- *Pleuronectes platessa*
- *Raja clavata*
- *Raja montagui*
- *Solea solea*

[62] Interpretation Manual of European Union Habitats. EUR27, July 2007. European Commission. DG Environment.

4.4.1 Range

Cardigan Bay SAC supports both rocky and biogenic reef types. Its rocky reefs are widespread and in the subtidal form a mosaic with areas of sand and gravel. Reefs in the bay consist largely of boulder, cobble and pebble, but along the beaches and just offshore there are occasional areas of bedrock. Biogenic reefs of the honeycomb worm *Sabellaria alveolata* are common in the intertidal and shallow subtidal environment, particularly in the northeast of the site. Indications are that subtidal reefs of the closely related species *Sabellaria spinulosa* may also be present.

Subtidal reefs are concentrated in the east of the SAC and tend to be more frequent close to shore in the south and west. The seabed of Cardigan Bay appears to be very patchy, forming a mosaic of seabed types, some of which seem to run parallel to the shore. This heterogeneity is greatest in the east and near shore, becoming more homogeneous offshore in the west. The distribution and extent of reefs within the site is therefore uncertain especially for subtidal areas.

4.4.2 Structure and function

The Bay's reefs fall into three main geomorphological categories;

- Raised areas of hard ground consisting of pebbles, cobbles and boulders. Present both subtidally and intertidally. They cover wide areas and appear to form a patchwork with more mobile patches of sediment.
- Biogenic reefs of the polychaete worm *Sabellaria alveolata*. Present predominantly in the intertidal, but extending into the subtidal. They grow on top of bedrock and hard ground where wave action suspends the sediment particles required by the worm for reef creation.
- Hard bedrock reef. Present subtidally and intertidal. These reefs have considerable topographical character and contain many fissures and crevices. The rocky shores of the south and west are typical of moderately exposed bedrock shores, with a good range of specialised habitats such as gullies, overhangs and pools. These reefs typically consist of bedrock ridges on the shore and into the subtidal, becoming broken bedrock that merges into boulders on sediments before eventually petering out into subtidal sediment plains. At the southern end of the site around Cemaes Head and Cardigan Island these reefs can extend over a kilometre offshore, but this diminishes rapidly up the coast so that bedrock reefs quickly become limited to the shore and immediately adjacent subtidal. Most of the site's sea-caves are also found here.

The majority of reef within Cardigan Bay SAC is moderately exposed, tide and/or sand swept mixed ground. The aggregations of consolidated and unconsolidated hard substrata (such as pebbles, cobbles & boulders) are intermixed with silts, sands and gravels. Although generally being sufficiently stable to support sessile organisms, the mobility of the reef structure and the scouring and smothering effects of the shifting sands and gravels have a strong influence on the habitat's community composition.

Large areas of reef surfaces are subject to intermittent or regular, long or short-term sediment cover depending on depth, topography, exposure to water movement and proximity to sediment sources. Overlying sediments vary from very fine deposits in wave and / or current sheltered locations to extremely coarse sands and fine shell gravel in current exposed offshore locations.

The biological interactions structuring reef ecology are known to be complex and include inter- and intra-species competition for space and resources, grazing and predation. The status of many biological interactions structuring ecology of reef communities and the population structures and dynamics of most key ecological structuring species are poorly known.

4.4.3 Typical species

The limited information on Cardigan Bay reefs suggests that species richness is high, though variable between and within reef habitats and over time. The range of substrate type, topography, depth, wave and tidal current exposures and light contribute to the high species variety.

The population sizes of particular species are unknown or poorly known as is population structure, biomass, physiological health and reproductive capability. Many invertebrate species on reefs have planktonic juvenile stages and are likely to be at least partly dependant on recruitment from outside the site.

The spatial range of most species characteristic of reef habitat is extensive, though the habitat range of many, particularly highly specialised species, is restricted in distribution and / or extent. Because of the hydrodynamic regime and the continuous throughput of water masses of distant and varied origins, species are inferred to be likely to be both capable of recruiting from and contributing to recruitment from both nearby and distant populations. The true ranges of apparently rare or scarce species are unknown.

4.4.4 Natural processes

The distribution and extent of reefs are shaped predominantly by physical conditions, including geology, geomorphological processes, water movement (mainly wave action and tidal streams) and sediment transport processes and, as such is dynamic and fluctuates.

The diversity and type of wildlife communities found on reefs varies according to the nature and type of rock habitat present and is strongly influenced by a number of physical characteristics, in particular how exposed or sheltered a site is to wave action and tidal currents. Extremely exposed areas are dominated by a robust turf of animals such as sponges and anemones and, in shallower water, foliose red seaweed, while reefs in the most sheltered locations such as sea lochs and rias support delicate or silt-tolerant seaweed, fan-worms, sea squirts and brachiopods. Stronger tidal streams often increase species diversity, although some communities require very still conditions. Other physical, chemical and biological factors are also an important influence on reef communities, such as depth, clarity of the water, salinity, whether there is a lot of sediment nearby or held in suspension in the water and has a scouring effect and availability of food supply. Temperature also has an important influence and in the UK there is a marked biogeographical trend in species composition related to temperature, with warm, temperate species such as the pink sea-fan (*Eunicella verrucosa*) occurring in the south, and cold-water species, such as the deeplet sea anemone (*Bolocera tuediae*) in the north.

Biogenic reefs are not as varied in comparison but do differ according to the local conditions of water movement, salinity, depth and turbidity. The main species which form biogenic reefs in the UK are blue mussels (*Mytilus edulis*), horse mussels (*Modiolus modiolus*), ross worms (*Sabellaria* spp.), the serpulid worm (*Serpula vermicularis*), and cold-water corals such as *Lophelia pertusa.* In addition to the reef-building animals,

biogenic reefs can be very rich in other species as the structure often provides more than one type of habitat. For example the sediment and spaces in and amongst the mussels of a horse mussel reef are suitable for some species whilst others live attached to the surface of the mussel bed. Biogenic reefs are often highly productive and may be important ecologically as feeding, settlement and breeding areas for many other species. In Cardigan Bay SAC the only biogenic reefs present are formed by the ross worm *Sabellaria* spp.

4.4.5 Modifications as a result of human activity

Reef features have historically been modified by human activity, for example as a result of coastal defence works, coastal construction, and use of heavy mobile fishing gear.

Reef geomorphology is assumed to be predominantly unmodified throughout the site with the distribution and extent of topographical reef types not known to have been reduced by human action. There is also no known evidence for modification of reef surface microtopography as a result of human activity, other than as part of gross modification of reef, but the use of heavy mobile fishing gear like bottom trawls and dredges is known to alter the topography of reef structures in quite major ways. The degree to which this has occurred within the site is unknown.

Remains of shipwrecks, lost and discarded fishing gear and persistent rubbish are present throughout the reef habitat and create a physical hazard to some species and may also be a source of chemical contamination. Modern synthetic fishing gears are capable of 'ghost fishing' both commercial and non-commercial species for prolonged periods. Many inert materials are colonised by marine wildlife (forming 'artificial reefs') though usually to the detriment of other, previously existing, species populations. Very small areas of intertidal reef have been covered by anthropogenic structures (e.g. outfall pipes).

There are limited localised anthropogenic influences on turbidity as a consequence of discharges (from sewage treatment works and local industry) and more pervasive influences as a consequence of land use influenced runoff, including farming practice and urban development. Increased storminess as a consequence of climate change is also likely to result in increasing levels of turbidity. Freshwater flows have been locally modified in the vicinity of managed or engineered watercourses where freshwater flow is concentrated. Long term outcome due to modified precipitation as a consequence of anthropogenically influenced climate change is uncertain.

The physiological health and reproductive capability of some species is inferred as potentially modified in areas of contaminant elevation and a variety of population dynamics are likely to have been, and continue to be, degraded by fishing activity. The mobility of commercially exploited species are (obviously) impeded by capture methods.

4.5 Submerged or partially submerged sea caves

Submerged or partially submerged sea caves (abbreviated to ***sea caves***) are defined in the EU Habitats Interpretation Manual as "*Caves situated under the sea or opened to it, at least at high tide, including partially submerged sea caves. Their bottom and sides harbour communities of marine invertebrates and algae*."

Caves can vary in size, from only a few metres to more extensive systems, which may extend hundreds of metres into the rock. There may be tunnels or caverns with one or more entrances, in which vertical and overhanging rock faces provide the principal marine habitat. The UK has the most varied and extensive sea-caves on the Atlantic coast of Europe. Sites encompass the range of structural and ecological variation of sea-caves and cover their geographic range in the UK. Selection was confined to well-developed cave systems, with extensive areas of vertical and overhanging rock, and those that extend deeply (ca. 4 m and more) into the rock, which are likely to support a wider range and higher diversity of plants and animals.

Some of the Welsh sea-caves are used as pupping sites by grey seals *Halichoerus grypus*. All the seacaves in Welsh SACs are considered to be of significant conservation value.

4.5.1 Range

Intertidal sea-caves are distributed widely throughout the site and are common wherever there are suitable geological exposures. The general distribution is generally well known but is poorly documented or mapped. The majority of caves are found towards the south-western end of the site, but are present almost anywhere where there are sea cliffs of relatively hard rock.

Submerged and partially submerged sea caves are distributed throughout the south western part of the site. The distribution of partially submerged sea caves is reasonably well known, though that of submerged sea-caves within the site is not. The extent of partially submerged sea-cave habitat is poorly known and that of submerged sea-caves is almost completely unknown.

The total number of sea caves is unknown and their extent is poorly known (especially for submerged sea caves). Individual sea caves range in size from little more than deep enclosed overhangs to more than 100m long. A few sea caves within the site have been specifically surveyed and based on this the area and volume of sublittoral caves is estimated as small.

4.5.2 Structure and function

Steep cliffs and eroding banks of alternating layers of Ordovician slates, shale and sandstones, characterise the coastline of the Cardigan Bay SAC. This geology along with prevailing hydrodynamics has a dominating effect on cave geomorphology. Rock structure, faulting and folding determine cave structure and axis of orientation. Combined with exposure, these determine erosion which modifies cave structure and function.

The floors of many sea caves are areas of sediment or mixtures of sediment and pebbles, cobbles and boulders, with sheltered locations in caves tending to accumulate silt. The sediments contribute to the habitat and species diversity and composition and have a strong influence on the amount of scouring of cave walls. Caves within the site have a wide range of shape, size, orientation and aspect, resulting in an equally wide range of hydrographic conditions and habitat variation.

Caves with boulder floors at and just below sea level are typically heavily scoured, with walls polished smooth by boulders thrown around by heavy wave action. The seabed slopes gradually away from the coast in much of the area, the seabed here is mixed

sediment, predominantly sand, and is easily churned up to add to the scouring action and heavy siltation which is characteristic of this area, particularly in the vicinity of the mouth of the Afon Teifi.

Many of the cave mouths face west where wave action has eroded out the strata of naturally weaker shale and slates leaving the harder sandstones. There are a greater number of caves to the west of Ynys Lochtyn where the rock is more suitable for cave formation and Cardigan Bay caves, particularly those at the western end of the site, can extend 100m into the cliff face due to the frequent vertical orientation of the rock layers.

The hydrography of the water column within and in the vicinity of sea caves is complex and highly variable spatially and temporally. Exposure to water movement varies throughout the site determined by depth / height, orientation, aspect, adjacent seabed / shore topography and sea cave morphology. Most caves are sheltered from currents inside while tidal streams outside can vary considerably. Most of the partially submerged sea caves are subject to at least moderate wave action. Many are regularly subject to extreme wave action and others are sheltered from all but the most severe wave action. Submerged sea caves are particularly exposed to strong wave surge.

The amount of light entering sea caves depends on their location, shape, aspect and adjacent coastal topography, and is a major influence on the species composition and diversity. Ambient light levels can be very different between caves. Caves with large entrances and a generally southern aspect usually receive some natural light in their deepest recesses, though in some cases insufficient to support plant growth. Many others, particularly with different aspects, that are narrow, have small entrances and are deep receive no natural light, like the submerged caves and long, north facing caves on Ramsey Island.

Particulate concentrations are generally significantly higher in sea caves subject to water movement with sediment floors or with a nearby sediment source, than levels in the adjacent external water column but also geographically and seasonally highly variable. The water and sediment chemistry is mostly likely to reflect that of the adjacent water column but modified by any groundwater seeps particularly in intertidal sea caves.

The mobilisation and deposition of sediment as a result of water movement is regular and widespread and many sea caves with sediment floors are therefore subject to rapid and considerable fluctuations in floor height and sedimentology. Intertidal *sea caves* (in particular) in the vicinity of sediments are subject to varying degrees of scouring from sediment movement, particularly low on cave walls.

Many sea caves provide highly favourable environmental conditions for key ecological structuring species (*e.g.* grazing molluscs, scavenging crustaceans). The possible presence of species atypical of areas immediately external to caves provides further opportunity for additional species interactions.

4.5.3 Typical species

The wide range of rock type, cave morphology, topography, depth and exposures to water movement, scour and light contribute to the high species diversity in sea caves within the site. Sea caves also typically support species that seem out of place, because caves provide environmental conditions which differ from those immediately outside the cave, for

example sponges typical of deep-water are sometimes found in intertidal caves and mud dwelling anemones in sediments on the floor of caves in exposed rocky areas. The number of marine algal and invertebrate species associated with sea-caves can be high, though highly variable between and within sea-caves.

Species populations in sea caves include those tolerant of scour, of extreme wave surge and cryptic, apparent cave specialist species, including the rare snail *Palludinella littorina*. The range of caves in different rock types increases species variety; caves in limestone have high diversity in part because of the complex microtopography of the rock surface and the species that can bore into the rock. Stable boulders and bedrock on the lower shore portions of the cave floors in the Cardigan area are colonised by *Sabellaria alveolata*. Although not often found as the large hummocks of honeycomb like tubes found on the open coast, the fresh growth of tubes in several of the caves reflect the turbid and sand-scoured conditions not found in caves in the other SACs in Wales.

Above high water mark, deep inside the caves, the walls support little other than biotic films grazed by small molluscs such as the limpet *Patella vulgata*. Where scour from cave floor sediments is high there is generally a largely barren zone of bedrock just above the mobile boulder floor. On the roofs of the caves, if out of reach from main surge, spiders *Meta menardi* are found with thin crusts of bluegreen algae, green algae, red velvety patches of *Audouinella* sp. and lichens where small amounts of light reach the rocky surfaces.

Spirorbid worms and barnacles (*Verruca stroemia* and *Semibalanus crenatus*) with patchy thin crusts of sponge including *Halichondria panicea*, *Myxilla incrustans* and other yellow encrusting sponge species and sparse anemones (*Actinia equina*) cover the less scoured intertidal parts of the cave walls towards the backs of the caves. Barnacles, anemones and limpets are more common towards the cave entrance eventually merging with biotopes normally encountered on open wave-exposed rock all along this stretch of coast.

Where cave walls have a lower shore and shallow subtidal section, for example on the south-west side of Cardigan Island and the east side of Cemaes Head, the sea squirt *Dendrodoa grossularia* is occasionally found at high densities, mixed with smaller patches of the white lace sponge *Clathrina coriacea*. These species are highly characteristic of wave-surge conditions. The most species-rich sections occur just below chart datum between 10-30m into caves. Patches of bright yellow sponge *Aplysilla sulfurea* and red *A. rosea* and *Ophlitaspongia papilla* are found on the walls, interspersed with colonial ascidians *Botrylloides leachii* and encrusting bryozoans such as *Flustrellidra hispida*. Towards the entrance, these short faunal turfs become more species-rich with other hydroids, ascidians and bryozoans.

Sea caves with beaches undisturbed by human activity are a favoured by grey seals for breeding and resting sites and tall sea caves with dry ceilings are favoured as bat hibernation sites. There is very little population data for non-mammalian species in sea caves and population structure is also poorly known or unknown for most species. The population dynamics of the typical reef and sediment living species is most likely to reflect those of the populations from which the species are recruited in the wider environment. The dynamics of species requiring highly specific cave conditions and with restricted range are unknown and the same is true in relation to physiological health, reproductive capability and recruitment.

The range of few cave-dwelling species is constrained by habitat requirements with most species living in sea caves being part of wider populations in nearby suitable habitats. Their distribution is mostly determined by recruitment from populations with widespread distributions both within and outside caves. A few cave specialists have a restricted distribution and are only known from few locations but it is unclear whether this is a function of survey effort or represents truly limited distribution. Species populations with genuinely restricted distribution are more vulnerable than those that may recruit from large, widespread populations.

4.5.4 Natural Processes

Cave morphology and topography is strongly determined by the underlying geology and erosion processes and has an important influence on qualities as a substratum for plants and animals. The microtopography, derived as a result of rock type and exposure to physical, chemical and biological processes also strongly influences niche diversity within caves. Localised protection from scour provided by microtopographical features for example, often strongly influences the distribution of sessile organisms within caves.

Physical conditions, such as inclination, wave surge, scour and shade, change rapidly from the cave entrance to the inner parts of a cave and this often leads to a marked zonation in the communities present. The combined effects of scour from suspended particulates and sediment and food particle supply is particularly important to the development, survival and diversity of cave species populations, especially in caves adjacent to sediment or with sediment floors.

Caves on the shore and in the shallow sublittoral zone are frequently subject to conditions of strong wave surge and tend to have floors of coarse sediment, cobbles and boulders. These materials are often highly mobile and scour the cave walls. Caves that occur in deeper water are subject to less water movement from the surrounding sea, and silt may accumulate on the cave floor. Intertidal sea cave communities and species ecology and function are strongly influenced by humidity and air temperature, mediated by air movement. Although overall air movement is climatic, movement may be reduced in sea caves depending on their structure and exposure to wave action. Air temperatures may be buffered as a result of restricted airflow, seawater and / or underground rock temperatures, and incident sunlight, compared to the adjacent external environments. Humidity may also be elevated as a result of reduced airflow as well as use by grey seals. In combination, these conditions in intertidal sea caves tend to favour species sensitive to desiccation.

4.5.5 Modifications as a result of human activity

Sea cave geomorphology is predominantly unmodified by human activity throughout the site. Other than gross modifications arising from sea cave collapse or infilling, there is no known evidence for modification of sea cave structural integrity, distribution, sedimentology or surface microtopography as a result of human activity.

Discarded and accidentally misplaced artificial materials are present in some sea caves. Lost and discarded fishing gear and persistent rubbish form a physical hazard to many species, particularly grey seals and other vertebrate species, and some are a source of chemical contamination. The variation in cave structure and hydrodynamics tends to both retain and flush out chemical contamination, including hydrocarbons, depending on exposure to water and air movements.

The gross physical hydrography and tidal streams within, and in the vicinity of sea caves, is considered little modified as a result of human activity. There is also no known evidence for modification of ambient light levels within sea caves as a result of human activity. Suspended particulate concentrations may be modified by localised or distant human activity including, for example, dredge spoil disposal, coastal protection or construction operations.

There is no known evidence for modification of sea cave air temperatures a result of human activity. However, it is possible that regular use of sea caves for recreational or eco-tourism purposes may increase air exchange (and also introduce atmospheric pollutants *e.g.* hydrocarbon exhaust fumes) No known evidence of modification of salinity in sea caves as a result of human activity but there is the potential for modification from changes in management of overlying land and watercourses.

Species populations in sea caves are exposed to nutrients and contaminants in groundwater seeps strongly influenced by agricultural or other management practices on overlying land surfaces. The magnitude and persistence of elevated hydrocarbons and exhaust gases in sea caves used by powered craft, and the potential consequences of such contaminants are unknown. Ecosystem functioning determined by grazing molluscs has been subject to temporary acute modification by pollution incidents. There is no known documented evidence of human activity having restricted physical access by grey seals to sea caves, other than temporary inhibition caused by human presence.

4.6 Sandbanks which are slightly covered by sea water all the time

Sandbanks which are slightly covered by sea water all the time are defined in the EU Habitats Interpretation Manual as:

“elevated, elongated, rounded or irregular topographic features, permanently submerged and predominantly surrounded by deeper water. They consist mainly of sandy sediments, but larger grain sizes, including boulders and cobbles, or smaller grain sizes including mud may also be present on a sandbank. Banks where sandy sediments occur in a layer over hard substrata are classed as sandbanks if the associated biota are dependent on the sand rather than on the underlying hard substrata”.

In this document they are referred to as ‘subtidal sandbanks’.

Within the UK’s inshore waters subtidal sandbanks can be categorised into four main sub-types:

- gravelly and clean sands
- muddy sands;
- eelgrass *Zostera marina* beds;
- maerl beds (composed of free-living Corallinaceae).

A variety of different sandbank types and their associated communities exist in Wales. Of the few moderate sized sandbanks in Wales there are those that are exposed to prevailing winds and currents e.g. Devils Ridge, Bastram Shoal (Pen Llŷn) and Bais Bank (Pembrokeshire) and those that are less exposed to these conditions e.g. the Four Fathom Banks complex and Constable Bank (off Colwyn Bay). As well as these types that occur in

fully marine environments there are also extensive mobile sandbanks that exist under reduced or variable salinity and turbid regimes in the Severn Estuary. The sandbanks of the Cardigan Bay SAC are of sub-type gravelly and clean sands.

There are two habitats and species of conservation importance (Environment (Wales) Act Section 7 and OSPAR threatened and declining habitats) that occur within this habitat. These are:

- Mud habitats in deep water
- Subtidal mixed muddy sediments (low confidence)

4.6.1 Range

The sandbanks of Cardigan Bay SAC are largely low-lying and most abundant in the east of the site, to the north and west of New Quay. There have been a few general studies in the bay that have sampled the sand bank areas and only one dedicated survey of sandbank habitat. The precise extent of sandbank features within the site is unknown however the general location of known subtidal sandbanks is shown in the feature map[63].

4.6.2 Structure and function

The Subtidal sandbanks vary considerably throughout the site according to sedimentology, seabed structure, bathymetry and hydrodynamics.

The sandbank features illustrate the variation between exposed (as these sandbanks are) and less exposed (to prevailing winds and weather) sandbanks. Their orientation is primarily along the axis of predominant tidal streams and the aspect varies within variation in axis of the tidal streams.

Very limited data are available on the sedimentology. The micro-distribution of sediments within the larger banks appears likely to be highly dynamic, while the gross distribution of the main banks themselves appears quite stable and stability is likely to increase with depth. The sandbanks are generally more sorted towards their tops with more mixed sediments towards their base. Sediments sampled in detail include banks in the New Quay area where they range from coarser-fine sand through to sandy gravel in the western part. The seaward side has a more mixed muddy sandy gravel substratum. The dune, wave and ripple microtopography of sandbanks are important sandbank microniches that contribute to habitat and species diversity.

Suspended particulate concentrations and water transparency are geographically and seasonally variable, though normally highest in open coast waters. Highest turbidity occurs during and following strong wave action, spring tides and heavy rainfall, typically in the winter months. There are also prolonged periods of low turbidity especially during spring and summer and in areas of weak tidal current streams. Whilst the exposed nature of the sites open coast sandbanks tends to minimise the presence of photosynthesising organisms such as *Zostera* spp, suspended fine particulates are relevant in terms of faunal feeding and respiration.

Nutrient concentrations within sediment structure are likely to be at or close to that of the surrounding water column although localised modification occurs where there are river and wastewater discharges.

[63] All features are contained in an interactive PDF map available on the NRW website, details of data used in the maps can be found in Annex 1.

Sandbanks are important, not just for the range and variation of community types and species present, but for their influence on the wider structural integrity of the surrounding habitats.

4.6.3 Typical species

The prevalent sandy community type along the Cardigan Bay coast is a ‘shallow Venus community’ or an ‘offshore sand association’. Because of the varied sediments the communities correspond with a variety of biotopes, including affinities with the shallow sand faunal communities. The west New Quay bank has a very rich and diverse range of taxa, mainly due to the coarse sands at the seaward side of the bank. Polychaete worms are common across the bank and other species recorded include shrimp-like crustaceans, bristleworms, molluscs, echinoderms and nemerteans

The medium-fine sands of the sandbanks are often dominated by the polychaete worms *Mediomastus fragilis* and *Ampharete finmarchica (*previously *lindstroemi)*, and the crustacean *Bodotria arenosa*. The coarser, more mixed sediments show a different collection of species and greater species diversity. Species found in large densities include the amphipod *Phtisica marina*, the tubeworm *Pomatoceros lamarcki ,* and the Ross worm *Sabellaria spinulosa*. Species found in lesser numbers include the mollusc *Corbula gibba*, the rosy feather star echinoderm *Antedon bifida*, the polychaete worms Eunereis (*Nereis) elittoralis* and *Caulleriellaalata*, and the amphipod *Ampelisca tenuicornis*, along with many other species and taxa that are often only found in mixed sediment environments. Uncommon polychaete worm species such as *Armandia polyophthalma* and the rare mantis shrimp *Rissoides desmaresti* have also been recorded here.

4.6.4 Natural processes

Subtidal sandbanks are dynamic features with their size, shape, aspect and orientation, as well as the macro- and micro-topography and sediment characteristics largely determined by the sediment supply and the influence of the hydrodynamic processes affecting each bank. They change shape over time and while some are ephemeral others may be relatively stable and long established. Mobile sediments that form temporary sandbanks are considered to be associated sediments that should be retained in the system but their location may change.

4.6.5 Modifications as a result of human activity

There is no known evidence of modification of exposure of the sandbanks to wave action or tidal streams or any changes in orientation as a result of human activity however the microtopography may have been modified by demersal fishing gear.

Sandbank structure has not been modified by sediment extraction within the site but dredge spoil disposal may have influenced the quality. The sediment composition has been modified such that there are raised levels of metals, particularly lead, due to historical mining activity. Mine waste waters enter the bay via river catchments, the Ystwyth and Rheidol being particularly significant. These continued inputs are of concern and the degree to which this represents a long-term cumulative threat is unknown. Evidence that cetaceans within the bay have raised levels of PCBs (see above) may indirectly reflect levels present in sediments and/or the water column.

5. Conservation Objectives

This latest version of the Regulation 37 package has been revised to improve accessibility of conservation objectives and to update the legislative context. The intent of the conservation objectives and of the advice on operations which may cause deterioration or disturbance to the feature is the same as in previous versions. The Conservation Objectives are now shorter and more generic but there has been no change in what is considered to represent Favourable Conservation Status.

In order to meet the aims of the Habitats Directive, the conservation objectives seek to maintain (or restore) the habitat and species features, as a whole, at (or to) favourable conservation status (FCS) within the site.

The Vision Statement is a descriptive overview of what needs to be achieved for conservation on the site. It brings together and summarises the Conservation Objectives into a single, integrated statement about the site.

5.1 Vision statement for Cardigan Bay

Our vision for the Cardigan Bay Special Area of Conservation (SAC) is one of a high quality marine environment, where the protected habitats and species of the site are in a condition as good as or better than when the site was selected; where human activities co-exist in harmony with the habitats and species of the site and where use of the marine environment is undertaken sustainably.

5.2 Conservation objectives for the Cardigan Bay Special Area of Conservation

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

5.2.1 Habitat Features

- Sandbanks which are slightly covered by seawater all the time
- Reefs
- Submerged or partially submerged sea caves

5.2.2 Range

The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing.
For the **reef** feature these include;

- Intertidal bedrock reefs
- Intertidal cobble, pebble with *Sabellaria alveolata* (biogenic) reefs
- Subtidal bedrock reefs
- Subtidal pebble, cobble and boulder reefs
- Sea caves

5.2.3 Structure and function

The physical biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded. Important elements include;

- geology,
- sedimentology,
- geomorphology,
- hydrography and meteorology,
- water and sediment chemistry,
- biological interactions.

This includes a need for nutrient levels in the water column and sediments to be:

- at or below existing statutory guideline concentrations
- within ranges that are not potentially detrimental to the long term maintenance of the features species populations, their abundance and range.

Contaminant levels in the water column and sediments derived from human activity to be:

- at or below existing statutory guideline concentrations
- below levels that would potentially result in increase in contaminant concentrations within sediments or biota
- below levels potentially detrimental to the long-term maintenance of the feature species populations, their abundance or range taking into account bioaccumulation and biomagnification.

5.2.4 Typical Species

The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded. Important elements include:

- species richness
- population structure and dynamics,
- physiological heath,
- reproductive capacity
- recruitment,
- mobility
- range

As part of this objective it should be noted that:

- populations of typical species subject to existing commercial fisheries need to be at an abundance equal to or greater than that required to achieve maximum sustainable yield and secure in the long term
- the management and control of activities or operations likely to adversely affect the habitat feature is appropriate for maintaining it in favourable condition and is secure in the long term.

5.2.5 Species Features

- Grey Seal
- Bottlenosed dolphin
- River Lamprey
- Sea Lamprey

5.2.6 Populations

The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include:

- population size
- structure, production
- condition of the species within the site.

As part of this objective it should be noted that for **bottlenose dolphin** and **grey seal**;

- Contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression

For **grey seal** populations should not be reduced as a consequence of human activity.

5.2.7 Range

The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.

As part of this objective it should be noted that for **bottlenose dolphin** and **grey seal**:

- Their range within the SAC and adjacent inter-connected areas is not constrained or hindered
- There are appropriate and sufficient food resources within the SAC and beyond
- The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing

5.2.8 Supporting habitats and species

The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include;

- distribution
- extent
- structure
- function and quality of habitat
- prey availability and quality.

As part of this objective it should be noted that;

- The abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.

- The management and control of activities or operations likely to adversely affect the species feature is appropriate for maintaining it in favourable condition and is secure in the long term.
- Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.
- Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour

5.2.8 Restoration and recovery

As part of this objective it should be noted that for the **bottlenose dolphin** populations should be increasing.

5.3 Understanding the Conservation Objectives

5.3.1 A dynamic marine environment

The conservation objectives recognise and acknowledge that the features are part of a complex, dynamic, multi-dimensional environment. The structures, functions (environmental processes) and species populations of habitat features are inextricably linked. Marine habitats are complex ecological webs of species, habitat structure and environmental functions that vary dynamically in time and space. Variety and change in habitat structure is primarily driven by environmental and physicochemical factors, including water movement, water quality, and sediment supply and prevailing weather conditions.

The species populations associated with these habitats also vary in time and space and this is, in part, a direct reflection of the variable habitat structure and dynamic environment. It is also the product of stochastic events and the great variation in survival and recruitment of species, particularly those with dispersive reproductive strategies.

Within the dynamism of habitats and species, there is also an element of stability and persistence, where species' and communities' populations as well as physical habitat structure show little overall long-term variation.

5.3.2 Human activities

These conservation objectives recognise and acknowledge that human activity has already modified and continues to modify habitats and species populations in various ways, to varying degrees and at varying spatial and temporal scales, either acutely or chronically. The conservation objectives do not aim to prevent all change to the habitat and species features, or to achieve an indefinable, abstract natural or pristine state, since these would be unrealistic and unattainable aspirations. Rather, they seek to prevent further negative modification of the extent, structure and function of natural habitats and species' populations by human activity and to ensure that degradation and damage to the features that is attributable to human activities or actions is prevented. Consequently, in order to meet the requirements of the Directive and ensure the site makes its appropriate contribution to conservation of biodiversity, the conservation objectives seek to:

- Encompass inherent dynamism rather than to work against it;
- Safeguard features and natural processes from those impacts of human activity that cause damage to the features through the degradation of their range, extent, structure, function or typical species;

- Facilitate, where necessary, restoration of features or components of features that are currently damaged or degraded and in unfavourable condition.

The term *degradation* is used to encompass damage or deterioration resulting only from such human activities or actions as have a detrimental effect on the feature. The magnitude of any degradation is dependent on the longevity and scale of the impact and the conservation importance of the species or habitats on which the impact occurs. This is influenced by:

- the type of human action, its nature, location, timing, frequency, duration and intensity;
- the species or habitats, and their intolerance and recoverability.

Outcomes arising from human action that are likely to be considered detrimental include such effects such as:

- permanent and long-term change of distribution or reduction in extent of a feature or feature component, or temporary modification or reduction sufficiently significant to negatively impact on biota or ecological processes;
- reduction in ecological function caused by loss, reduction or modification of habitat structural integrity;
- interference in or restriction of the range, variety or dynamism of structural, functional or ecological processes, *e.g.*: alteration of habitat structure, obstruction of tidal streams, chronic or acute thermal, salinity or suspended sediment elevations or reductions;
- hypertrophication or eutrophication;
- contamination by biologically deleterious substances;
- reduction in structure, function and abundance of species populations;
- change in reproductive capacity, success or recruitment of species populations;
- reduction in feeding opportunities of species populations
- reduction of health to a sub-optimal level, or injury, rendering the population less fit for, *inter alia,* breeding, foraging, social behaviour, or more susceptible to disease;
- increase in abundance and range of opportunist species through the unnatural generation of preferential conditions (*e.g.* organic enrichment), at the expense of existing species and communities.
- increase in abundance and range of non-native species.

Table 2 provides illustrative examples of specific changes and whether they would constitute degradation of the feature.

It is important to note that many human activities can either be beneficial (reduce or reverse detrimental human influence (*e.g.* improve water quality)), trivial (*e.g.* no significant and/or substantive long-term effect) or benign (no outcome) in terms of their impact on marine habitats and species.

Advice on potentially detrimental human activities is provided in Section 6 (activities or operations which may cause damage or disturbance to features).

Table 2: Examples of change and whether they would constitute degradation of the feature.

Degradation	Not Degradation
Reduction in grey seal reproductive potential as a result of sub optimal physiological health caused by high tissue burdens of anthropogenically derived contaminants.	Reduction in grey seal reproductive potential as a result of sub optimal physiological health caused by density dependent incidence of endemic disease.
Modification of a seabed community by organically rich effluent from a new sewage outfall.	Modification of a seabed community as a result of a reduction in organic material entering the sea from a sewage outfall.
Change in seabed community composition as a result of coastal engineering that has altered local wave exposure.	Change in seabed community composition as a result of a cliff fall, the debris from which has altered local wave exposure.
Change to the species composition of a seabed community as a result of an increase in scallop dredging intensity.	Change to the composition of a seabed community as a result of a reduction in scallop dredging intensity.
Permanent reduction of extent of sand and mud-flat as a result of new coastal development.	Permanent reduction of extent of sand and mud-flat as a result of long-term natural changes in sediment transport.
Changes in sediment granulometry as a result of beach recharge operations	Changes in sediment granulometry as a result of natural cliff fall and erosion

5.3.3 Use of the conservation objectives – Site management

The components of favourable conservation status detailed in the conservation objectives have different sensitivities and vulnerabilities to degradation by human activities. Conservation and protection of site features is provided by management, which should be based on levels of risk. The form of management and degree of protection necessary will vary spatially, temporally and from one feature component to another due to their differences in conservation importance and their sensitivity and susceptibility to change as a result of human action. Therefore it needs to be understood that these conservation objectives require a risk-based approach to the identification, prioritisation and implementation of management action.

Security of management is provided in part 6, sections 59 to 66, of the Conservation of habitats and Species Regulations 2017, which require the assessment of plans and projects likely to have a significant effect on the site.

Where there is a potential for a plan or project to undermine the achievement of the conservation objectives, NRW will consider the plan/project to be likely to have a significant effect and require appropriate assessment. Unless it is ascertained, following an appropriate assessment, that a plan or project will not undermine the achievement of the conservation objectives, the plan/project should be considered as having an adverse effect on the integrity of the site[64].

Appropriate and secure management of activities may also be provided through a site management plan.

[64] Uncertainity should not result in a conclusion of no adverse effect on site integrity.

6. Advice as to operation which may cause deterioration or disturbance to the features

The range of different habitat types within each of the SAC's features is extremely wide and marine habitats and species populations are inherently dynamic. The range and scale of both natural and anthropogenic stressors on the marine habitats and species within the SAC are also very large. Human activities have the potential to impose stresses on each habitat's structure and function in many ways that result in acute, chronic or permanent impacts at different spatial scales. Species populations may also be affected at many levels e.g. physiological, genetic, single organism, population and groups of species.

Table 3 identifies where there is a potential for operations or activities to have an adverse effect on a feature or component of a feature exists. This does not imply a significant actual or existing causal impact. The potential for, and magnitude of, any effect will be dependent on many variables, such as the location, extent, scale, timing and duration of operations or activities, as well as proximity to features that are sensitive to one or more factors induced or altered by the operation. Due to the complexity of the possible inter-relationships between operations or activities and the features, the factors and effects listed in this table are the predicted most likely effects and are not exhaustive.

- The 'activity' column lists potentially damaging operations and gives an indication of their current known status within the SAC. Operations or activities marked with an asterisk (*) may have associated consents, licences, authorisations or permissions which are (or may be) plans or projects, within the meaning of Article 6 of the Habitats Directive. (The potential effects of the construction phase of operations marked with a hash (#) are included in the general operation 'construction'.
- The 'relevant factors' column (physical, chemical and biological factors) give an indication of the key mechanisms by which the operation or activity may cause an effect on each habitat feature.
- The 'most likely relevant component and effects' column indicates the most likely components of Favourable Conservation Status that might be affected by each operation or activity.
- The 'features' columns indicate which Annex 1 habitats and Annex II species could potentially be affected by the operation or activity.
- The 'advice as to likely required action' column provides an indication of the actions required (from NRW and others) to undertake specific risk assessments of relationships between the operation or activity and relevant features, including any further information that would be necessary to further refine / tailor advice.

Table 3: Operations which may cause deterioration or disturbance to the features

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
DOCKS, MARINAS & SHIPPING										
Dock, harbour & marinas structures: Construction* *Occasional in harbours*	Geophysical regime: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate Fundamental environmental parameters: changes to available oxygen; turbidity; suspended sediments Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, crushing, abrasion, smothering visual, noise	✓	✓	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution; particularly intertidal habitats. Structure & function: modification of physical structure and morphology; modification of hydrodynamic, sediment transport, and turbidity regimes, water and sediment chemistry; mobilisation / addition of contaminants; introduction of anthropogenic material; noise/visual disturbance effecting mobile species particularly mammals; modification to local hydrodynamic regime effecting exposure sensitive communities/species; elevated suspended sediments and contaminants limiting growth of benthic flora, smothering sessile benthic species and increasing likelihood of toxic bioaccumulation; modification to sediment transport leading to changes in local habitat structure; modification to biological processes including food contamination and availability, and changes to biological interactions due to modification to habitat and physical factors. Conservation status of typical species & species features: likely decrease in species/community diversity, effects to population dynamics, and restrictions to range of mobile species (especially migratory fish) dependant on location and extent of proposed construction. *Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate. Consenting bodies ensure appropriate integration, inclusion and consultation Consenting bodies ensure assessment of cumulative effects in association with others plans and projects
Dock, harbour & marinas structures: Maintenance* *Common in harbours*	Environmental quality: addition of toxic and non-toxic contaminants (biocides, oxidising and reducing agents, petrochemicals, suspended particulates) Physical disturbance: displacement, crushing, abrasion, smothering visual, noise	✓	✓	✓	✓	✓	✓	✓	Structure & function: noise/visual disturbance effecting mobile species particularly mammals; localised elevated suspended material and contaminants limiting growth of benthic flora, smothering sessile benthic fauna and increasing likelihood of toxic bioaccumulation; modification to biological processes including food contamination and availability. Conservation status of typical species & species features: likely decrease in species diversity and effects to population dynamics dependant on location and extent of proposed maintenance and materials used. *Operation specific information required: location, extent, scale, frequency, timing and duration; materials (paint, cleaning agents etc.) used; relevant site-specific biotic and abiotic information.*	Treat as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce.
Dredging: capital * *None at present. Future proposals for*	Geophysical regime: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate	✓	✓	✓	✓	✓	✓	✓	Structure & function: habitat loss and change; noise/visual disturbance effecting mobile species particularly mammals; modification to local hydrodynamic regime effecting exposure sensitive communities/species; elevated suspended sediments and contaminants limiting growth of benthic flora, smothering sessile	Treat as plan or project as appropriate. Establish best operational practices suitable to secure

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Teifi estuary possible.	Fundamental environmental parameters: changes to available oxygen; turbidity; suspended sediments Environmental quality: increased suspended nutrients; remobilisation of toxic & non-toxic contaminants (increasing bioavailability) Physical disturbance: displacement, abrasion, smothering, visual, noise Other factors: removal of biota								benthic fauna and increasing likelihood of toxic bioaccumulation; modification to sediment transport leading to changes in local habitat structure; modification to biological processes including food contamination and availability, and changes to biological interactions due to loss and modification of habitat and physical factors. Conservation status of typical species & species features: alteration/reduction in species/community diversity and extent. Also an alteration/reduction in quality of communities/populations containing species sensitive to changes in turbidity, light, oxygen, smothering and toxic contaminants (particularly shallow subtidal algal and eelgrass communities, species-rich sediment infaunal communities, sponge communities). *Operation specific information required: location, extent, scale , timing and duration; relevant location-specific biotic and abiotic information*	features at FCS
Dredging: Maintenance* *Common in harbours*	Geophysical regime: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate Fundamental environmental parameters: changes to available oxygen; turbidity; suspended sediments Environmental quality: increased suspended nutrients; toxic & non-toxic contaminants Physical disturbance: displacement, abrasion, smothering, visual, noise Other factors: removal of biota	✓	✓	✓	✓	✓	✓	✓	Structure & function: habitat modification; noise/visual disturbance effecting mobile species particularly mammals; modification to local hydrodynamic regime effecting exposure sensitive communities/species; elevated suspended sediments limiting growth of benthic flora, and smothering sessile benthic fauna; modification to sediment transport leading to changes in local habitat structure; remobilisation of toxic & non-toxic contaminants (increasing bioavailability) modification to biological processes including food contamination and availability, and changes to biological interactions due to modification of habitat and physical factors. Conservation status of typical species & species features: alteration/reduction in species/community diversity and extent. Also an alteration/reduction in quality of communities/populations containing species sensitive to changes in turbidity, light, oxygen, smothering and toxic contaminants (particularly shallow subtidal algal and eelgrass communities, species-rich sediment infaunal communities, sessile faunal turf communities). *Operation specific information required: location, extent, scale, timing and duration; frequency of operation and proximity to healthy populations for recruitment; relevant location-specific biotic and abiotic information*	Treat as plan or project if appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce.
Shipping: vessel traffic *Large commercial ships: Unlikely, although some areas may be used for sheltering purposes in poor weather conditions.* *Visitor passenger boats: Common, but limited in extent as they repeatedly use the same routes (seasonally skewed*	Geophysical regime: vessel wash - substrate erosion, local modification of wave exposure regime Fundamental environmental parameters: turbidity Physical disturbance: collision, noise, visual	✓	✓	✓	✓	✓	✓	✓	Structure & function: local effects to sediment habitat structure; noise/visual disturbance effecting mobile species particularly mammals; potential for collision with seals; local modification of physical processes with elevated levels of suspended sediments effecting benthic flora, and smothering sessile benthic fauna; modification to biological processes including food availability, and changes to biological interactions due to modification of habitat and physical factors. Conservation status of typical species & species features: particularly effecting the diversity, health and extent of wave sheltered communities and the distribution of communities along physical gradients. Also an alteration/reduction in quality of communities/populations containing species sensitive to changes in turbidity, light, oxygen and smothering (particularly shallow subtidal algal and eelgrass communities, species-rich sediment infaunal communities, and sessile faunal turf communities). *Operation specific information required: location, frequency and duration of operation; scale of effect of wash and water movement from vessel movement dependent on vessel size, activity, speed and proximity to sensitive (sheltered, intertidal and /or shallow subtidal) habitats/communities and species (seals);*	Determine effects of vessel movement on sediment transport, mobilisation and turbidity. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters to minimise risk to features FCS

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
between April – October) *Fishing vessels: widespread but minimal impacts*									*relevant location-specific biotic and abiotic information*	
Shipping: Mooring* *Commercial vessels (fishing vessels): Common and widespread in harbours and the Teifi Estuary* *Recreational vessels: Common and widespread in harbours and the Teifi Estuary (seasonally skewed between April - October)*	Geophysical regime: local alteration / loss of substrate; local modification of sediment transport Physical disturbance:, displacement, crushing, & abrasion			✓	✓	✓		✓	Structure & function: habitat modification and loss through introduction of anthropogenic material; physical disturbance to adjacent habitats/communities; local modification of physical processes; modification to biological processes including competition for space and food availability, and changes to biological interactions due to modification of habitat and physical factors. Conservation status of typical species & species features: alteration/reduction in quality of sediment communities/populations containing species sensitive to continuous substrate disturbance (particularly algal and eelgrass communities, and species-rich sediment infaunal communities). *Operation specific information required: location, extent, frequency, timing and duration; size and construction of mooring(s), frequency of use and proximity to sensitive habitats/communities; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat new mooring developments as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of moorings in open coastal locations.
Shipping: anchoring *Commercial vessels: unlikely although some areas may be used for sheltering purposes in poor weather conditions* *Recreational vessels: Widespread & common (seasonally skewed for recreational vessels between April – October)*	Geophysical regime: local modification of substrate structure & sediment transport Physical disturbance: crushing, abrasion & displacement.	✓	✓			✓			Structure & function: habitat modification; physical disturbance; local modification of physical processes with raised suspended particulate concentrations; modification to biological processes including food availability, and changes to biological interactions due to modification of habitat and physical factors. Conservation status of typical species & species features: alteration/reduction in quality of sediment communities/populations containing species sensitive to substrate disturbance (particularly algal, maerl and eelgrass communities, and species-rich sediment infaunal communities) and alteration/reduction in quality of rocky communities/populations containing species sensitive to physical impact (particularly physically fragile and long-lived species of corals, sponges and bryozoans). *Operation specific information required: location, extent, frequency, timing and duration; size/types of anchor(s); proximity to sensitive habitats/communities*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of open coastal locations used as commercial anchorages and for casual recreational anchoring
Shipping: Vessel maintenance (incl. antifouling) *Widespread & common for recreational and local commercial vessels.*	Environmental quality: addition of toxic & non-toxic contaminants - (organo-metals, biocides, oxidising and reducing agents, petrochemicals); organic enrichment	✓	✓	✓	✓	✓	✓	✓	Structure & function: habitat modification through introduction of anthropogenic material; elevated suspended particulates limiting growth of benthic flora and smothering sessile benthic fauna; chemical contamination increasing likelihood of toxic bioaccumulation; modification to biological processes including food contamination and availability, and changes to biological interactions due to modification to habitat and physical factors. Conservation status of typical species & species features: effects to population dynamics and likely decrease of diversity and health in species/communities sensitive to organometal compounds, biocides, bleaches etc. (particularly chronic effects on sediment, molluscan, algal and macrophyte species).	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
									Operation specific information required: location, extent, scale, frequency, timing and duration; types of antifouling compounds and other materials employed, disposal methods used; proximity to sensitive habitats/communities/populations.	
Shipping: Ballast water discharge *Ballast water convention now in force.*	Environmental quality: organo-metals (antifoulants) Other factors: introduction of non-native species	✓	✓	✓	✓	✓	✓	✓	Structure & function: chemical contamination increasing likelihood of toxic bioaccumulation; modification to biological processes including food contamination and availability, and changes to biological interactions due to the introduction of new species. Conservation status of typical species & species features: effects on population dynamics and likely decrease of diversity and health in species/communities sensitive to antifouling contaminants. Alteration of ecological processes and community structures by introduced species which may compete with and/or predate on native species (including pests on commercial species) and spread disease. Possible increase in bloom forming algae. *Operation specific information required: location, extent, scale, frequency, timing and duration; origin of ships and likelihood of ballast water discharge within the site; baseline data (occurrence and status) on non-indigenous species present within the site.*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters to minimise risk to features FCS
Shipping: Refuse & sewage disposal *Likely to be widespread offshore*	Environmental quality: addition of toxic (metals, synthetic organic compounds, microbial pathogens) & non-toxic (nutrients, inert particulates and materials) contaminants. Physical disturbance: entanglement, smothering	✓	✓	✓	✓	✓	✓	✓	Structure & function: water and sediment quality; habitat modification through introduction of anthropogenic material; physical disturbance; local modification of sediment processes with raised suspended particulate concentrations; elevated suspended particulates modifying turbidity & ambient light (limiting growth of benthic flora) and smothering sessile benthic fauna; chemical contamination leading to toxic effects; modification to biological processes including food contamination and availability, and changes to biological interactions due to modification to habitat and physical factors. Conservation status of typical species & species features: effects on species variety, population dynamics, physiological health in species sensitive to organo-metal compounds, biocides, bleaches etc. (particularly chronic effects on sediment, molluscan, algal and macrophyte species); entanglement (grey seal, erect benthic invertebrates including a low growing, long lived species e.g. sponges, corals); local smothering. *Operation specific information required: location, extent, scale, frequency, timing and duration; types and toxicity of waste; relevant location-specific biotic and abiotic information*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS
Shipping: operational discharges *Likely to be widespread offshore*	Environmental quality: addition of toxic & non-toxic contaminants particularly hydrocarbons; organic enrichment Physical disturbance: smothering	✓	✓	✓	✓	✓	✓	✓	Structure & function: elevation of water (and sediment) contaminant and / or nutrient burden. Conservation status of typical species & species features: effects on species variety, composition, population dynamics & physiological health in species sensitive to hydrocarbons, organo-metal compounds, biocides, bleaches etc.; nutrient enrichment *Operation specific information required: location, extent, scale, frequency, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS
Shipping: accidents -may be associated	Geophysical regime: local modification of			✓	✓	✓	✓	✓	Structure and function: physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment)	Maintain, keep under review and improve as appropriate, shipping

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
with cargo / bunkers discharges *Rare*	substrate structure & topography Environmental quality: addition of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing abrasion; visual; noise								hydrocarbon contaminant burden. Conservation status of typical species & species features: local effects on populations of species sensitive to physical impacts &/or hydrocarbon contamination; effects on species variety, abundance, dynamics, physiological health. *Operation specific information required: location, extent, scale, timing and duration; type, amount and toxicity of discharges; relevant location-specific biotic and abiotic information*	management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents - fuel oil & / or petrochemical discharges *Rare*	Environmental quality: addition of toxic & non-toxic contaminants particularly petrochemicals Physical disturbance: smothering	✓	✓	✓	✓	✓	✓	✓	Structure & function: elevation of water and sediment hydrocarbon contaminant burden; decrease in habitat quality; modification of biological interactions following decline in populations of ecologically structuring species (*e.g.* grazing molluscs) Conservation status of typical species & species features: lethal and sub lethal physiological effects on species sensitive to hydrocarbons; effects on population variety, abundance, dynamics, physiological health. *Operation specific information required: location, extent, scale, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information*	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents- non-petrochemical cargo losses / discharges *Rare*	Geophysical regime: local modification of or addition to substrate Environmental quality: addition of toxic & non-toxic contaminants - potentially wide range of organic & inorganic materials & particulates. Physical disturbance: displacement, amputation, abrasion, smothering	✓	✓	✓	✓	✓	✓	✓	Structure & function: elevation of water and sediment contaminant burdens; decrease in habitat quality. Conservation status of typical species & species features: lethal and sub lethal physiological effects on species sensitive to discharge; effects on population variety, abundance, dynamics, physiological health. *Operation specific information required: location, extent, scale, timing and duration; type, amount and toxicity of discharge; relevant location-specific biotic and abiotic information*.	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents - salvage operations *Rare*	Geophysical regime: local modification of or addition to substrate Environmental quality: addition of toxic & non-toxic contaminants - petrochemicals, synthetics & metals debris Physical disturbance: displacement, amputation, crushing, abrasion, noise; visual	✓	✓	✓	✓	✓	✓	✓	Structure and function: physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment) contaminant burdens. Conservation status of typical species & species features: local effects on populations of species sensitive to physical impacts &/or potential contaminants; effects on species variety, abundance, dynamics, physiological health. *Operation specific information required: location, extent, scale, timing, duration and nature; likely effects and outcome; relevant location-specific biotic and abiotic information*.	Maintain, keep under review and improve as appropriate, management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Provide environmental advice to salvage managers and salvors.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
CIVIL ENGINEERING										
Construction* *Not intensive*	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: potentially acute effects on any component factors, potentially chronic effects particularly on suspended particulates / turbidity Environmental quality: addition of toxic & non-toxic contaminants - particulates, synthetics & metals debris, petrochemicals Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise; visual	✓	✓	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution; particularly intertidal habitats. Structure & function: modification of physical structure and morphology; modification of hydrodynamic, sediment transport, water and sediment chemistry and turbidity regimes; mobilisation / addition of contaminants; introduction of anthropogenic material; noise/visual disturbance effecting mobile species particularly mammals; modification to local hydrodynamic regime effecting exposure sensitive communities/species; elevated suspended sediments and contaminants limiting growth of benthic flora, smothering sessile benthic species and increasing likelihood of toxic bioaccumulation; modification to sediment transport leading to changes in local habitat structure; modification to biological processes including food contamination and availability, and changes to biological interactions due to modification to habitat and physical factors Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; indirect modification of population structure, physiological health, reproductive capacity. *Operation specific information required: location, extent, scale and nature of construction; timing and duration of operation; relevant location-specific biotic and abiotic information*	Treat as plan or project, taking into account proposed subsequent operational use and maintenance. Consenting bodies ensure appropriate integration, inclusion and consultation Consenting bodies ensure assessment of cumulative effects in association with others plans and projects
Land claim *# *Occasional*	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: turbidity Environmental quality: toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual	✓	✓	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution. Structure & function: modification of physical structure and morphology; modification of hydrodynamic, sediment transport and turbidity regimes, and water and sediment chemistry; addition of contaminants Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; consequential near and far-field modification of species population structure, physiological health, reproductive capacity. *Operation specific information required: location, extent and scale of reclamation; timing and duration of operation; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate, taking into account proposed subsequent operational use and likely effects.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Coast protection / defence (including beach replenishment) *# *Widespread adjacent to coastal settlements*	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: suspended sediments, turbidity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	✓	✓	Extent & distribution: potential loss of / reduction in habitat extent. Structure & function: modification of physical structure (particularly sedimentology) and morphology; change of habitat type; modification of hydrodynamic, sediment transport and turbidity regimes, sediment chemistry; addition of contaminants Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; consequential near and far-field modification of species variety, extent, distribution, particularly sediment living species adjacent to wave exposed coastlines. *Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate, taking into account proposed subsequent operational use and likely effects.
Barrages (amenity, storm surge, tidal) *# *None at present unlikely in future due to lack of suitable locations.*	Geophysical regime: modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure Fundamental environmental parameters: modification of salinity, suspended sediments, turbidity, dissolved oxygen, temperature, seabed illuminance Environmental quality: toxic & non-toxic contaminant build-up; modification of suspended particulates; organic enrichment Physical disturbance: displacement	✓	✓	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution, *e.g.* estuary and encompassed (particularly intertidal and rocky) habitats; chronic loss of reef through siltation in enclosed waterways Structure & function: upstream of barrage: change of habitat type(s); modification or loss of characterising geomorphology of features (ria, estuaries, tidal narrows); loss or change of habitat structure, sedimentology & bathymetry; disruption of hydrodynamic regime (including tidal regime) & sediment transport processes; modification of suspended particulates, turbidity, light; modification of water and sediment chemistry (salinity regime, deoxygenation, eutrophication, contaminant & nutrient accumulation); increased homogeneity of habitats within impounded areas Downstream from barrage: modification of habitat structure, sedimentology; hydrodynamic regime; sediment transport processes; suspended particulates, turbidity, water (and sediment) chemistry, particularly salinity regime and nutrient / contaminant fluxes. Conservation status of typical species & species features: decrease in species variety, modification of distribution; change in species composition from fully saline and mixed salinity to low salinity species. Consequential near and far-field modification of species population structure, physiological health, reproductive capacity. Reduction in species ranges (reproductive propagules of sessile biota and movement of mobile biota including vertebrates and species features) *Operation specific information required: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate, taking into account proposed subsequent operational use and likely effects.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Artificial reef*# *There is artificial reef at Borth with plans for another at Aberaeron*	Geophysical regime: modification of tidal, streams, wave exposure, substrate, sediment transport Fundamental environmental parameters: modification of salinity, suspended sediments, turbidity, dissolved oxygen, temperature, seabed illuminance Environmental quality: modification of suspended particulates Physical disturbance: displacement, smothering,	✓	✓	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent Structure & function: change of habitat type(s); modification or loss of structure, characterising geomorphology, sedimentology & bathymetry; disruption of hydrodynamic regime & sediment transport processes; modification of suspended particulates, turbidity, light; modification of biological interactions (change in habitat type and altered balance of predator and grazer species) Conservation status of typical species & species features: modification in species variety, distribution, composition, ranges *Operation specific information required: location, extent, scale of structure; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate
Engineered freshwater watercourses *# *Limited*	Geophysical regime: substrate, sediment transport Fundamental environmental parameters: modification of salinity, suspended sediments, turbidity Physical disturbance: displacement	✓	✓						Structure & function: localised, and potential far-field, modification of salinity regime and water circulation. Conservation status of typical species & species features: localised modification of species distribution, composition and variety. *Operation specific information required: location, extent, and scale of modification to discharge; timing and duration of construction; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate.
Power station *# *None at present within SAC.*	Fundamental environmental parameters: thermal discharge; local modification of salinity Environmental quality: addition of toxic contaminants - biocides; atmospheric discharge; deposition of toxic & non-toxic contaminants	✓	✓	✓	✓	✓	✓	✓	Structure & function: localised, and potential far-field, modification of thermal regime; salinity and water circulation; possible increase in contaminants. Conservation status of typical species & species features: localised modification of species distribution, composition, variety; modification of physiological health, reproduction, survival and competitive ability. Facilitation of survival and reproduction of non-native species. *Operation specific information required: location, extent, scale, frequency, timing, duration and nature of operations affecting features; location, scale, frequency, timing, duration and content of discharges, relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate.
Pipelines *#	Geophysical regime: addition of artificial substrate; local modification of water movement Physical disturbance: displacement, visual, noise.	✓	✓	✓	✓	✓	✓	✓	Structure & function: dependent on depth of pipeline burial in seabed – modification of sediment transport processes and local hydrodynamic regime. Conservation status of typical species & species features: dependent on depth of pipeline burial in seabed – localised modification of species composition, variety. *Operation specific information required: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate, taking into account long term management requirements & likely effects.
Power / communication cables *# *Present*	Geophysical regime: addition of artificial substrate; local modification of water movement Physical disturbance: displacement, visual, noise. Potential electro-magnetic effects of electrical cables. Scour effect on benthic habitats from cables due to	✓	✓	✓	✓	✓	✓	✓	Structure & function: dependent on depth of cable burial in seabed – modification of sediment transport processes and local hydrodynamic regime. Conservation status of typical species & species features: dependent on depth of cable burial in seabed – localised modification of species composition, variety. Modification of behaviour caused by electro-magnetic effects. *Operation specific information required: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-*	Treat as plan or project as appropriate, taking into account long term management requirements & likely effects.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
	wave action.								*specific biotic and abiotic information.*	
WASTE DISPOSAL										
Effluent disposal* (sewage & chemical) *Widespread & common*	Geophysical regime: modification of & addition to substrate Fundamental environmental parameters: elevation of suspended particulates; oxygen depletion Environmental quality: addition of toxic and non-toxic contaminants - nutrients, microbial pathogens, surfactants, hormone mimics, petrochemicals, PAHs, PCBs, metals & organometals, organohalides, biocides and other organic & inorganic compounds; organic enrichment Physical disturbance: smothering	✓	✓	✓	✓	✓	✓	✓	Structure & function: direct modification of water quality through elevation of toxic and non-toxic contaminants, nutrients and suspended particulates; indirect modification of sediment quality, salinity, oxygen levels. Conservation status of typical species & species features: water quality directly or indirectly affects habitats feature species and species features. The range of composition of industrial and domestic effluents is extremely wide and the potential impacts arising from the various chemical constituents span the full breadth of biological components of the features. Primary effects on the physiological health of species leading to declines in species population and variety and shifts to opportunistic pollution tolerant species; *inter alia:* - effects of eutrophication and deoxygenation on sediment-living species, caused by organic enrichment & increase in nutrients: disruption to competitive balance in favour of opportunist species and decrease in species richness, consequent decrease in community diversity; increase in opportunistic algal growth - smothering low shore and shallow water algal and macrophyte species - decrease in species variety and physiological health; - direct / indirect, sub lethal / lethal, chronic / acute toxic impacts on algae and invertebrates - *e.g.* chronic species depletion of sediment communities - increased turbidity / suspended particulates - interference with feeding mechanisms and processes in reef dwelling species - decrease in health of species and community diversity - effects of endocrine (hormone) disruptors, persistent bioaccumulated organic toxins (*e.g.* PCBs) on health and reproduction of vertebrates, including grey seal feature - disruption of characteristic ecological structure of features through indirect impacts on predator, scavenger, ecologically structuring species. *Operation specific information required: type, amount, content and toxicity of discharge; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	Treat new discharges and proposed changes to existing discharges as plan or project as appropriate.
Effluent disposal: thermal* *None at present*	Fundamental environmental parameters: thermal regime; possibly also salinity, suspended particulates; oxygen depletion	✓	✓	✓	✓	✓	✓	✓	Structure & function: local modification of thermal regime; possible modification of salinity regimes and water quality depending on content of discharge Conservation status of typical species & species features: effects on species survival, competitive and reproductive capabilities; consequential changes in population sizes and species variety. Potential facilitation of survival and reproduction of non-native species. *Operation specific information required: location, frequency, timing and duration, volume, flow and degree of difference from ambient temperature of discharge; relevant location-specific biotic and abiotic information.*	Treat new discharges and proposed changes to existing discharges as plan or project as appropriate.
Sludge dumping* *None at present*	Geophysical regime: modification of & addition to substrate Fundamental environmental parameters: elevation of suspended particulates;	✓	✓	✓	✓	✓	✓	✓	Structure & function: direct modification of water and sediment quality through elevation of, nutrients, suspended particulates, toxic and non-toxic contaminants and inert materials; local eutrophication and modification of dissolved oxygen; local (and far field) modification of sedimentology. Conservation status of typical species & species features: effects on the	Treat as plan or project as appropriate.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
	oxygen depletion Environmental quality: addition of nutrients; suspended; toxic & non-toxic contaminants; microbial pathogens; organic enrichment Physical disturbance: smothering								physiological health of species leading to declines in species population and variety, and shifts to opportunistic pollution tolerant species; largely through effects of nutrient enrichment and eutrophication. Magnitude of effects proportional to distance from disposal location. *Operation specific information required: type, amount, content and toxicity of discharge; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
Wastes & debris (including refuse & litter) *Widespread & common*	Geophysical regime: addition of persistent artificial substrates Environmental quality: Addition of toxic & non-toxic contaminants Physical disturbance: entanglement, smothering	✓	✓	✓	✓	✓	✓	✓	Structure & function: local modification of structure, morphology, topography; local modification sediment transport processes, hydrodynamic regime; degradation of inherent quality of habitats; entanglement and/or obstruction of mobile species Conservation status of typical species & species features: modification of species composition; population sizes; range and mobility. *Operation specific information required: location, extent, scale, frequency, timing, duration, nature and composition of disposal; relevant location-specific biotic and abiotic information*	Maintain, keep under review and improve as appropriate port waste management plans Secure appropriate promotion & enforcement of national and international dumping at sea measures so as to minimise risk to features' FCS Education & awareness raising
Dredge spoil disposal * *Aberystwyth: dredge spoil used to replenish beach immediately north of Aberystwyth south beach. Sediment resuspended and flushed by neap tides.* *Aberaeron: dredge spoil used to replenish Aberaeron North beach. Sediment resuspended and flushed by neap tides.* *New Quay: dredge spoil used to replenish Traeth y Dolau*	Geophysical regime: modification of sediment transport processes; alteration to substrate Fundamental environmental parameters: changes to suspended sediments, turbidity; dissolved oxygen Environmental quality: increased nutrients; remobilisation of toxic & non-toxic contaminants Physical disturbance: smothering	✓	✓	✓	✓	✓	✓	✓	Structure & function: local modification of sedimentology, topography, sediment transport processes, suspended particulates/turbidity, water and sediment chemistry – remobilisation and redeposition of contaminants; far-field effects (*e.g.* elevated suspended sediments) depending on scale of operation and hydrodynamic regime at disposal point. Conservation status of typical species & species features: modification of species composition – shift toward more disturbance tolerant species; effects on population sizes, physiological health, reproduction, biomass. *Operation specific information required: location, extent, scale, frequency, timing, duration, nature and composition of spoil and nature and composition of contamination of spoil; relevant location-specific biotic and abiotic information.*	Treat proposed spoil disposal out with a designated spoil disposal site as plan or project as appropriate. Develop and implement best practice appropriate for disposal sites
Urban & industrial run-off* *Widespread & common*	Fundamental environmental parameters: suspended particulates – increased turbidity; oxygen depletion Environmental quality: addition of toxic & non-toxic contaminants - petrochemicals, PAHs, PCBs, metals & organo-metals, organohalides, biocides, surfactants,	✓	✓	✓	✓	✓	✓	✓	Structure & function: modification of water & sediment chemistry – nutrient enrichment; contaminant increases; potential local modification of suspended particulates. Conservation status of typical species & species features: modification of physiological health and consequential effect on species reproduction, composition and variety; potential increases in opportunist algal species (including plankton blooms and consequential effects) from nutrient enrichment,	Continued surveillance and monitoring of inputs and water quality by NRW. Continued development and promotion of good practice. Maintain review of consents to take account of new scientific

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
	hormone mimics, oxidising and reducing agents, and other organic & inorganic compounds.								modification of species composition and biomass. *Operation specific information required: location, extent, scale, frequency, timing, duration, composition of run-off; improved information on type, scale and synergistic effects of toxic contaminants; relevant location-specific biotic and abiotic information*	information. Include in assessment of plans and projects as appropriate
Agricultural run-off *Widespread & common*	Geophysical regime: addition to substrate, modification to hydrodynamic regime & sediment transport Fundamental environmental parameters: elevation of suspended sediments; oxygen depletion Environmental quality: addition of toxic & non-toxic contaminants - nutrient & organic carbon enrichment, biocides (herbicides, pesticides, fungicides), surfactants.	✓	✓	✓	✓	✓	✓	✓	Structure & function: modification of water & sediment chemistry – nutrient enrichment; contaminant increases; increase in suspended particulates/turbidity; decrease in light penetration through water column, increased oxygen demand. Conservation status of typical species & species features: modification of physiological health and consequential effect on species reproduction, composition and variety; contrary effects on plant species from nutrient enrichment and decreased light; potential increases in opportunist algal species (including plankton blooms and consequential effects), modification of species composition and biomass. *Operation specific information required: location, extent, scale, frequency, timing, duration, composition of run-off; relevant location-specific biotic and abiotic information*	Continued surveillance and monitoring of inputs and water quality by NRW; continued development and promotion of good practice.
EXPLOITATION OF LIVING RESOURCES										
Trawling (beam, otter) & dredging: scallop (and other relatively rapidly towed, heavy seabed gears not listed below)* Scallop dredging takes place in part of the site. Other trawling occurs but intensity and effort information is unknown.	Geophysical regime: modification of substrate; addition of persistent inert debris Fundamental environmental parameters: elevation of turbidity & suspended particulates. Physical disturbance: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise Other factors: removal of target species	✓	✓	✓	✓	✓		✓	Structure & function: modification of sedimentology – decrease in sediment habitat heterogeneity, sediment transport processes; damage to rocky habitat structure; modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features). Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects. *Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	Scallop fishing has been assessed and is controlled within the site. Other trawling: To secure features at FCS, assess the impacts from the activity on the features of the site
Dredging: mussel and oyster* *None at present, possible development of mussel seeding in the future.*	Geophysical regime: modification of substrate Fundamental environmental parameters: elevation of turbidity & suspended particulates Physical disturbance: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise Other factors: removal of target species	✓	✓	✓	✓	✓	✓	✓	Structure & function: modification of seabed structure, sedimentology, sediment transport processes; damage to rocky habitat structure; modification of biological reef structures (*e.g.* mussel); modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features) Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours	To secure features at FCS, assess the impacts from the activity on the features of the site

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
									and consequential effects. *Operation specific information required: gear type and size; target species; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	
Dredging: hydraulic dredge *None at present,*	Geophysical regime: modification of substrate Fundamental environmental parameters: elevation of turbidity & suspended particulates Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, crushing, amputation, smothering Other factors: removal of target species	✓	✓	✓	✓	✓	✓	✓	Structure & function: modification of seabed structure, sedimentology, suspended particulates & sediment transport processes; modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; indirect effect on reef species from elevated suspended particulates / turbidity - sub lethal impacts on invertebrate species (smothering, impedance of feeding mechanisms) *Operation specific information required: gear type; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.
Netting: (gill, tangle, trammel, beach seine, demersal seine, salmon, fyke)* *Gill netting – localised & seasonal. Tangle netting increasing in response to increases in Spider crab* *Other nets not known to be used within SAC at present*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: entanglement, displacement (target & non-target species), amputation, abrasion Other factors: removal of target species	✓	✓	✓	✓	✓	✓	✓	Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), removal of ecologically structuring species (predators & scavengers) as by-catch, modification of prey availability for predators (including species features). Lost net will degrade habitat quality and create chronic entanglement risk. Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, e.g. damage / displacement of fragile, erect benthic reef species; entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost netting. *Operation specific information required: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site
Potting *Widespread & common (inshore waters)*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: displacement, crushing & abrasion Other factors: removal of target species	✓	✓	✓	✓	✓	✓	✓	Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), potential reduction of prey availability for predators (including species features) Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, *e.g.* bycatch, damage / displacement of fragile, erect benthic reef species, entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost pots. *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Commercial line fishing *Occasional and localised hand fishing (mackerel),*	Physical disturbance: displacement Other factors: removal of target species	✓	✓	✓	✓	✓		✓	Structure & function: potential reduction of prey availability for predators (including species features) Conservation status of typical species & species features: depletion of target & non-target species populations and modification of population structures. *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site
Hand gathering: (collection, boulder turning, digging, raking, spearfishing)* *Widespread but low intensity.*	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species	✓	✓			✓			Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and variety (e.g. increase in predatory species) in sediment habitats; potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site
Bait collection: commercial* *None known of at present, likely to be present at limited levels.*	Geophysical regime: modification of substrate physical structure (direct and indirect through addition of artificial habitat to attract bait species, e.g. 'crab tiles') Fundamental environmental parameters: elevation of turbidity; reduced oxygen, local salinity modification ('salting') Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement; possible crushing, amputation & smothering Other factors: removal of target species	✓	✓		✓	✓	✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (*e.g.* sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species (including ecologically structuring species); modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of non-target species composition and variety (*e.g.* increase in predatory species) in sediment habitats; potential depletion of vertebrate predator prey species *Operation specific information required: target species and shore type; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site
Collection, for aquarium / curio trade *Intensity and effort information is unknown*	Physical disturbance: displacement, amputation, visual Other factors: removal of target species	✓	✓	✓	✓	✓		✓	Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species Conservation status of typical species & species features: depletion of target species populations and modification of target & non-target species population structures. *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Gathering algae and higher plants for human consumption (see also vehicles on foreshore) *None known of at present, likely to present at limited levels*	Physical disturbance: displacement, crushing & amputation Other factors: removal of target species					✓			Structure & function: disturbance or modification of habitat structure by mechanical harvesting Conservation status of typical species & species features: modification of target species population size and structures *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site
CULTIVATION OF LIVING RESOURCES										
Aquaculture: wild stock enhancement / 'ranching' * *None at present*	Geophysical regime: modification of substrate structure, sedimentology, sediment transport Fundamental environmental parameters: oxygen depletion Environmental quality: organic enrichment Physical disturbance: displacement, smothering Other factors: introduction of non-native species	✓	✓	✓	✓	✓		✓	Structure & function: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (nutrients, contaminants, sediment oxygen depletion); modification of biological interactions (*e.g.* predator-prey relationships) Conservation status of typical species: decrease in species variety (except possibly in low variety habitats), modification of species composition, population sizes, structures, dynamics and ranges; increase in population size and range of (invertebrate) predatory species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.
Aquaculture: finfish, crustaceans; sea or waterway based cages or impoundments * *None at present*	Fundamental environmental parameters: oxygen depletion Environmental quality: toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants Other factors: introduction of non-native species	✓	✓	✓	✓	✓		✓	Extent & distribution: potential decrease in (intertidal) habitat extent Structure & function: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) Conservation status of typical species & species features: local modification of species physiological health, variety, composition within zone of influence; modification of behaviour and range of predatory species (including species features) *Operation specific information required: location, extent and scale; species and aquaculture practices; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.
Aquaculture: molluscan 'farming' * (molluscan culture using trestles, ropes, cages or other structures) *None at present although interest has*	Fundamental environmental parameters: oxygen depletion Environmental quality: nutrient & organic enrichment; possible addition of pesticides & antifoulants Other factors: introduction of non-native species	✓	✓	✓	✓	✓		✓	Structure & function: modification of habitat structure, sedimentology, sediment processes; reduction in habitat quality (introduction of artificial substrate); modification of water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand); modification of biological interactions (*e.g.* predator-prey relationships) Conservation status of typical species & species features: local modification of species physiological health, variety, composition within zone of influence; increase in population size and range of (invertebrate) predatory species; modification of behaviour and range of predatory vertebrate species (including species features)	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
been expressed. Some mussel see trials present.									*Operation specific information required: species and aquaculture structures; location, extent, scale and duration; relevant location-specific biotic and abiotic information*	
Aquaculture: land based semi-enclosed / recirculation * # *None at present*	Fundamental environmental parameters: oxygen availability; turbidity Environmental quality: nutrient & organic enrichment; biocides, antibiotics	✓	✓	✓	✓	✓		✓	Structure & function: modification of water chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) Conservation status of typical species & species features: local modification of species physiological health, variety, composition within zone of influence *Operation specific information required: location, extent, scale; content, volume frequency and duration of discharges; relevant location-specific biotic and abiotic information*	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.
EXPLOITATION OF NON-LIVING RESOURCES.										
Water abstraction* *Abstraction from freshwater inputs site-wide.*	Geophysical regime: modification of flow regime Fundamental environmental parameters: salinity	✓	✓	✓	✓	✓		✓	Structure & function: local modification of hydrography, temperature, water chemistry & salinity regime Conservation status of typical species & species features: modification of species variety and composition within zone of influence *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Treat new proposed developments as plan or project as appropriate. Review existing consents
Aggregate extraction * (mineral & biogenic sands & gravels) *None at present*	Geophysical regime: removal and alteration of substrate; modification of sediment transport, wave and tidal stream regimes Fundamental Environmental Parameters: elevation of turbidity / suspended particulates Physical disturbance: displacement, smothering Other factors: removal of biota;	✓	✓			✓	✓	✓	Extent & distribution: potential decrease in size of sandbanks and modification in extent of sediment features Structure & function: modification of habitat structure, sedimentology, morphology, sediment transport processes, hydrodynamics Conservation status of typical species & species features: modification of species composition and variety, including decline in species adapted to sandbank habitat conditions; effects on population sizes, physiological health, reproduction, and biomass. *Operation specific information required: target aggregate & method of extraction; location, extent, volume, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate.
Oil & gas exploration: seismic survey* *Gas exploration in west of site.*	Physical disturbance: noise (dependant on proximity to site)							✓	Conservation status of typical species & species features: sub-lethal physiological effects & modification of behaviour of vertebrate species (including species features) *Operation specific information required: location, extent, scale, frequency, timing duration and nature; relevant location-specific biotic and abiotic information*	Treat new proposed developments as plan or project as appropriate.
Oil & gas exploration & production: drilling operations* *Gas exploration in west of site.*	Geophysical regime: substrate modification Environmental quality: hydrocarbon contamination Physical disturbance: displacement, crushing, smothering in immediate vicinity; noise	✓						✓	Structure & function: modification of water chemistry (contaminants), habitat quality (presence of artificial substrates); local modification of biological interactions through changes to prey availability Conservation status of typical species & species features: modification of species composition and variety (increase in species typical of hard substrate) *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Treat new proposed developments as plan or project as appropriate.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Oil & gas exploration & production: operational* & accidental discharges *Gas exploration in west of site.*	Geophysical regime: modification of substrate Environmental quality: petrochemicals, toxic contamination Physical disturbance: general physical effects	✓						✓	Structure & function: water & sediment chemistry: elevation of contaminants (particularly hydrocarbons) and nutrient concentrations. Conservation status of typical species & species features: effects on species variety, composition, population dynamics & physiological health in species sensitive to hydrocarbons, organo-metal compounds, biocides, bleaches etc.; nutrient enrichment. *Operation specific information required: location, extent, scale, frequency, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information*	Treat new proposed developments as plan or project as appropriate.
Alternative energy production: tidal barrage*# *None at present, unlikely due to lack of suitable locations.*	Geophysical regime: modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure Fundamental environmental parameters: salinity, suspended particulates, turbidity, dissolved oxygen, temperature, seabed light Environmental quality: toxic & non-toxic contaminant accumulation; organic enrichment	✓	✓	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution, *e.g.* estuary and encompassed (particularly intertidal and rocky) habitats; chronic loss of reef through siltation in enclosed waterways Structure & function: upstream of barrage: change of habitat type(s); modification or loss of characterising geomorphology of features (ria, estuaries, tidal narrows); loss or change of habitat structure, sedimentology & bathymetry; disruption of hydrodynamic regime (including tidal regime) & sediment transport processes; modification of suspended particulates, turbidity, light; modification of water and sediment chemistry (salinity regime, deoxygenation, eutrophication, contaminant & nutrient accumulation); sediment transport processes; increased turbidity; increased homogeneity of habitats within impounded areas. Downstream from barrage: modification of habitat structure, sedimentology; hydrodynamic regime; sediment transport processes; suspended particulates, turbidity, water (and sediment) chemistry, particularly salinity regime and nutrient / contaminant fluxes. Conservation status of typical species & species features: decrease in species variety, modification of distribution; change in species composition from fully saline and mixed salinity to low salinity species; consequential near and far-field modification of species population structure, physiological health, reproductive capacity. Reduction in species ranges (reproductive propagules of sessile biota and movement of mobile biota including vertebrates and species features) *Operation specific information required: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate.
Alternative energy production: coastal wave & tidal current *# *None* at *present*	Geophysical regime: modification of wave and tidal regimes; removal & alteration of substrate Environmental quality: possible toxic & non-toxic contaminants; modification of suspended particulates Physical disturbance: displacement, crushing, smothering by structures or anchoring mechanisms; collision; noise	✓	✓	✓	✓	✓	✓	✓	Extent & distribution: potential habitat loss within footprint of generating structures Structure & function: potentially highly variable dependent on nature, construction and scale of structures. Modification of habitat structure, sedimentology & sediment processes, hydrodynamic regime Conservation status of typical species & species features: modification of species variety, distribution, physiological health (collision, entrainment); modification of species ranges (disturbance; artificial reef effects) *Operation specific information required: type, construction & size; location & extent; timing and duration of installation; permanence; anchoring structures; cabling requirements; maintenance requirements & frequency; relevant*	Treat as plan or project as appropriate.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
									location-specific biotic and abiotic information	
Alternative energy production: wind *# *Development interest feasible.*	Geophysical regime: modification of wave and tidal regimes; modification to substrate Environmental quality: possible toxic & non-toxic contaminants Physical disturbance: general physical effects; possible collision	✓	✓				✓		Extent & distribution: potential habitat loss within footprint of generating structures Structure & function: potentially highly variable dependent on nature, construction and scale of structures. Modification of sedimentology & sediment processes, hydrodynamic regime Conservation status of typical species & species features: modification of species variety, & distribution; modification of species ranges (disturbance; artificial reef effects) *Operation specific information required: type, construction & size; location & extent; timing and duration of installation; permanence; cabling requirements; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate.
POLLUTION RESPONSE										
Oil spill response: at sea *Reactive only. No recent activity*	Environmental quality: toxic contamination - petrochemicals, surfactants, demulsifiers Physical disturbance: noise, visual	✓	✓	✓	✓	✓	✓	✓	Structure & function: modification of water chemistry (with purpose of ameliorating degree of modification) Conservation status of typical species & species features: acute modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics (primarily shallow sediment & reef species, fish and mammals, including species features) *Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information*	Develop and maintain appropriate pollution response contingency plans Inclusion and maintenance of information on site features and sensitivity to at-sea response activities in West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning – washing *Reactive only. No recent activity*	Geophysical regime: modification & removal of substrate Fundamental environmental parameters: salinity; temperature Environmental quality: toxic contamination - petrochemicals Physical disturbance: displacement, crushing, abrasion, noise, visual	✓	✓	✓	✓	✓		✓	Structure & function: local modification of habitat structure, salinity, thermal regime; water & sediment chemistry (remobilisation and/or sediment entrapment of hydrocarbon contaminants); Conservation status of typical species & species features: acute local depletion of population sizes, effects on physiological health and potential consequential population dynamics and distribution effects. Disturbance of vertebrate species, including species features *Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information*	Develop and maintain appropriate pollution response contingency plans Inclusion and maintenance of information on site features and sensitivity to on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning – chemical *Reactive only. No recent activity*	Environmental quality: addition / increase petrochemicals, surfactants, demulsifiers Physical disturbance: including displacement	✓	✓	✓	✓	✓		✓	Structure & function: modification of water & sediment chemistry; modification of biological interactions through changes in abundance and contamination of food resources Conservation status of typical species & species features: acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics *Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information*	Develop and maintain appropriate pollution response contingency plans Inclusion and maintenance of information on site features and sensitivity to on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Oil spill response: shore cleaning – physical *Reactive only. No recent activity*	Geophysical regime: modification & removal of substrate Environmental quality: toxic contamination - petrochemicals Physical disturbance: displacement, crushing, abrasion, trampling, noise, visual	✓	✓	✓	✓	✓			Structure & function: modification of habitat structure, sedimentology, water & sediment chemistry through remobilisation and transfer of hydrocarbon contamination Conservation status of typical species & species features: acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Develop and maintain appropriate pollution response contingency plans Inclusion and maintenance of information on site features and sensitivity to on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning - ancillary activities (access creation, vehicular impacts, wildlife rescue) *Reactive only. No recent activity*	Geophysical regime: modification of substrate Environmental quality: toxic contamination - petrochemicals Physical disturbance: displacement, crushing, abrasion, smothering, collision, noise, visual Other factors: removal of biota	✓	✓	✓	✓	✓			Structure & function: modification of habitat structure, sedimentology Conservation status of typical species & species features: acute local modification of species population sizes, structures, physiological health; disturbance and displacement of vertebrate species including species features *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Develop and maintain appropriate pollution response contingency plans Inclusion and maintenance of information on site features and sensitivity to on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan Treat as plan or project as appropriate.
RECREATION										
Angling *Occurs extensively throughout the site but intensity and effort information is unknown.*	Environmental quality: metals, persistent inert debris Physical disturbance: displacement, entanglement Other factors: removal of target species	✓	✓				✓	✓	Structure & function: local modification of habitat quality through depletion of vertebrate species food resources; disturbance; discarded & lost debris and equipment; modification of local biological interactions (predator-prey relationships) Conservation status of typical species & species features: local depletion of fish species populations; local modification to sensitive species populations through entanglement, displacement (intertidal and vertebrate species including species features); potential by-catch of fish species features *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising To secure features at FCS, assess the impacts from the activity on the features of the site.
Bait collection: boulder turning *Widespread low intensity*	Geophysical regime: modification of substrate physical structure Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species;	✓	✓			✓			Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of biological interactions (ecosystem effects) through depletion of target species (including ecologically structuring species); modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of non-target species composition and variety (*e.g.* increase in predatory invertebrate species) in sediment habitats; potential depletion of vertebrate predator prey species. *Operation specific information required: target species and shore type (exposure); location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Bait collection: digging & other sediment shore collection techniques* *Widespread low intensity*	Geophysical regime: modification of substrate physical structure; sediment transport Fundamental environmental parameters: turbidity; oxygen; salinity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement; possible crushing, amputation, smothering, visual Other factors: removal of target species	✓	✓		✓	✓			Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (*e.g.* sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species (including ecologically structuring species); modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of non-target species composition and variety (*e.g.* increase in predatory invertebrate species) in sediment habitats; potential depletion of vertebrate predator prey species. *Operation specific information required: target species and shore type; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising To secure features at FCS, assess the impacts from the activity on the features of the site.
Recreational boating: high speed power craft (see also mooring and anchoring) *Present, particularly in summer months close to shore and points of access/safe havens* *Proposal for new marina at Fishguard will increase recreational boating*	Geophysical regime: modification of substrate physical structure; wave exposure regime Fundamental environmental parameters: turbidity Environmental quality: hydrocarbon contaminants; organic enrichment Physical disturbance: displacement, collision, noise, visual	✓	✓	✓	✓	✓			Structure & function: local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local modification of water quality (hydrocarbon and other contaminants) Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of species composition *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: low speed power craft (see also mooring and anchoring) *Present, particularly in summer months close to shore and points of access/safe havens*	Geophysical regime: modification of substrate physical structure; wave exposure regime Fundamental environmental parameters: turbidity Environmental quality: hydrocarbon contaminants; organic enrichment Physical disturbance: displacement, collision, noise, visual			✓	✓	✓	✓		Structure & function: local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local modification of water quality (hydrocarbon and other contaminants) Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of species composition *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: sail (see also mooring and anchoring) *Present, particularly in summer months*	Physical disturbance: displacement, collision, noise & visual			✓	✓	✓	✓		Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
close to shore and points of access/safe havens.										
Recreational boating: canoeing (see also mooring and anchoring) *Present, particularly in summer months close to shore and points of access/safe havens. Low intensity.*	Physical disturbance: displacement, collision, noise & visual			✓	✓	✓	✓		Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: other non-mechanically powered craft (see also mooring and anchoring) *Low intensity*	Physical disturbance: displacement, collision, noise & visual			✓	✓	✓	✓		Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: moorings* *Localised low intensity.*	Physical disturbance: displacement, collision, noise & visual	✓	✓	✓	✓	✓			Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: anchoring* *Localised low intensity.*	Physical disturbance: displacement, collision, noise & visual	✓	✓	✓	✓	✓			Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Casual shore recreation (bathing, dog walking, coasteering etc.) *Present, widespread; seasonally skewed; spatially variable. Numbers and spatial distribution unquantified.*	Environmental quality: organic enrichment, microbial pathogens, persistent inert materials Physical disturbance: general physical effects; trampling; noise; visual	✓	✓	✓	✓	✓	✓		Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species composition *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising
Vehicles on foreshore	Geophysical regime: substrate Physical disturbance: crushing collision,	✓	✓	✓	✓	✓			Structure & function: modification of habitat sedimentology, geomorphology, sediment processes	Activity surveillance

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Infrequent	noise; visual								Conservation status of typical species & species features: local modification of benthic species composition and population structures, particularly sediment habitats; disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Appropriate implementation of SSSI procedures & access byelaws
Light aircraft *Occasional*	Physical disturbance: noise & visual			✓					Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance
Wildfowling	Environmental quality: metals, persistent inert materials Physical disturbance: crushing; noise; visual	✓	✓	✓	✓	✓			Structure & function: modification of sediment chemistry (heavy metal contamination); habitat modification (manipulation to encourage target species) Conservation status of typical species & species features: local modification of sediment benthic species population structures, particularly sediment habitats; disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance Education & awareness raising Review, monitor and enforce spatial, temporal and effort operational limits suitable to secure features at FCS Appropriate implementation of SSSI procedures & access byelaws
Marine wildlife watching / eco-tourism *Present, moderate to high intensity. Seasonally skewed.*	Physical disturbance: noise & visual			✓	✓				Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance
MILITARY ACTIVITIES										
Military activity: ordnance ranges* *Present*	Environmental quality: metals, persistent inert materials Physical disturbance: noise; visual	✓	✓	✓	✓	✓	✓		Structure & function: modification of water quality Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; potential effects of contaminants on physiological health *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Research potential effects on features
Military activity: marine exercises *Present*	Environmental quality: metals, persistent inert materials Physical disturbance: noise; visual	✓	✓	✓	✓	✓	✓		Structure & function: modification of water quality Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Research potential effects on features
Military activity: aircraft *Present*	Physical disturbance: noise & visual			✓	✓				Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
MISCELLANEOUS OPERATIONS AND USES										
Marine archaeology & salvage *No data available*	Fundamental environmental parameters: turbidity Environmental quality: metals Physical disturbance: displacement, abrasion, crushing, amputation, noise; visual	✓	✓	✓	✓	✓			Structure & function: potential local modification of sedimentology and sediment transport, geomorphology, water quality (mobilisation of contaminants) Conservation status of typical species & species features: local modification of species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising
Education & science *Education unknown; science limited, focussed on dolphins*.	Physical disturbance:: displacement, crushing, noise, visual Other factors: species removal	✓	✓	✓	✓	✓			Structure & function: local modification of geomorphology, biological interactions Conservation status of typical species & species features: local modification of benthic species population structures; disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, develop and/or implement and monitor best practice suitable to secure features at FCS Appropriate implementation of SSSI procedures & access byelaws Development and encouragement of information exchange
Animal welfare operations & sanctuaries *Present*	Environmental quality: potential release of microbial pathogens Physical disturbance: noise, visual Other factors: habituation of wild species to humans								Conservation status of species features: effects on population physiological health (survival and release of low-fitness individuals), potential exposure to domestic disease; potential disturbance and modification of range and behaviour *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance Education & awareness raising Review, develop and/or implement and monitor best practice suitable to secure features at FCS

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Annexes

Annex 1 Cardigan Bay SAC feature map: interpretation guide

The data found within the Cardigan Bay SAC feature map represents the indicative location of the Annex 1 marine features for which the site has been designated, namely:

- **Sandbanks** which are slightly covered by seawater all the time
- **Reefs**
- Submerged or partially submerged **sea caves**

All feature definitions are taken from the "Interpretation Manual of European Union Habitats[65]"

The following text provides some background information on how each of these feature map layers was compiled including relevant data sources, and any changes that have been made compared with the original indicative feature distributions that were mapped at the time of site designation.

Note:

i. The maps only represent indicative locations of each feature type. They do not show habitat absence. There are areas of seabed within Welsh SACs that have not been mapped or surveyed and therefore the possibility exists for features to be present in other locations i.e. the white areas of the maps. Similarly, the exact boundaries of each feature extent may not be accurate due either to a lack of recent survey data or the mobile nature of some features.
ii. Features such as reefs and sandbanks may occasionally overlap. This is due to the mobile nature of the seabed meaning that sediment may move from time to time (e.g. seasonally or after storm events) to either cover or expose rocky areas beneath.
iii. When MHW or MLW lines are referred to, these relate to Ordnance Survey Mastermap GIS layers.
iv. Features do not appear to sit exactly on top of the coastline in some areas (e.g. intertidal reef polygons or sea cave lines) due to differences in the map datum / projection of the source data and the OS background map.

Sandbanks

The feature extent outline for the sandbank features found within Cardigan Bay SAC is based on the following data sources:

- JNCC Astrium Digital Seabed Elevation Model
- Marine survey data (biology and sediments)
- UKHO Admiralty Charts and bathymetry data
- Expert knowledge

The indicative sandbank feature polygons within the SAC have been updated using data developed and refined during a UK-wide sandbank delineation programme (undertaken by JNCC in conjunction with CCW in 2012 for reporting against Article 17 of the Habitats Directive). This programme used a digital elevation model along with acoustic datasets (multibeam and RoxAnn) and habitat survey data (biology and sediments) where available

[65] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

to more accurately delineate areas of seabed that fit within the Annex 1 Sandbanks definition. Survey data has also been used to help delineate areas that are part of the sandbank feature extent. As a result the sandbank boundaries in the Cardigan Bay SAC have been updated and refined.

A distinction has been made between sandbank areas that are classed as 'Definite' i.e. where the sandbanks adequately meet the criteria set out in the Annex 1 feature definition, and 'Potential' i.e. where there is some uncertainty over whether the bank area adequately meets the Annex 1 feature requirements. This could be due to lack of topographic distinctness or uncertainty over sediment composition and associated biological communities.

Reefs
The indicative reef polygon feature map for Cardigan Bay SAC is composed of extensive areas of both intertidal and subtidal habitat. Data sources for the indicative feature extent map are:

- CCW Phase 1 Intertidal Habitat Map (intertidal reef areas)
- Marine survey data (biology and sediments)
- Admiralty charts
- British Geological Survey seabed sediment and rock substrate maps
- Expert knowledge

'Definite' and 'Potential' areas of reef are identified in the feature layer to differentiate between areas where the supporting data shows the feature is definitely known to be present (Definite), and where the feature could be either transient in nature (e.g. due to mobility of sediments that could cover rocky outcrops), part of a mixed sediment seabed where other features could also be present (e.g. a mixed shore or mosaic seabed where both soft sediments and hard substrate are interspersed), or where supporting data is less reliable (Potential).

The reef map from Cardigan Bay SAC has been updated using data from the 2012 Habitats Directive Article 17 reporting process, during which the reef areas were refined based on recent survey data (where available).
A reef point location map has also been provided to show where biological records exist for reef habitats from subtidal survey work.

Sea caves
The sea caves feature is represented as both points (known cave locations) and lines (sections of the coast where caves are known to occur) derived from survey work. The lines follow the Mean Low Water boundary and represent indicative rather than actual cave locations.

A small number of additional sea cave locations have been added to the feature map from recent survey records.

Annex 2 Glossary of Terms

Meaning of the following terms as employed in this conservation advice:

Term	Meaning as employed in this conservation advice
baroclinic	Seawater circulation pattern arising when density and pressure gradients are perpendicular to each other
benthos; benthic	The forms of marine life that live on, or in, the sea or ocean bottom. Pertaining to the sea or ocean bottom.
bioaccumulation	The uptake and retention of a 'bioavailable' chemical form from any one of, or all possible external sources (*cf* biomagnification *qv*).
biodiversity	Biodiversity has been widely defined and is understood in various ways. It is widely used to capture the concept of the 'variety of life' and includes genetic, species and community diversity.
biogenic	Produced directly by the physiological activities of organisms, either plant or animal (Baretta-Bekker *et al* 1998). Biogenic reefs – long-lived, hard, biological structures comprised of large numbers individual organisms such as mussel or sand-tube building worms *Sabellaria*.
biomagnification	The process whereby a chemical, as it is passed through a food chain or food web, builds to increasingly higher concentrations in the tissues of animals at each higher trophic level (*cf* bioaccumulation *qv*).
biotic and abiotic *factors* (*qv*)	Biotic: "Pertaining to life … influences caused by living organisms", *cf* abiotic: "characteristics and elements of the environment (which) influence survival or reproduction of organisms, that are not alive themselves" (Baretta-Bekker *et al ibid*) Influences and elements of both a biological and non-biological nature that: • contribute to the composition of a habitat, its structure, function or biology (*i.e.* the factors that the comprise habitat, as defined in Habitats Directive, Article 1f: "*habitat of a species* means an environment defined by specific abiotic and biotic factors, in which the species lives at any stage of its biological cycle"); • contribute to a result or to bringing about a result; • affect the course of events. Many factors are *processes* (*qv*) Biotic factors include competitive interaction (e.g. for space and food, predation, scavenging and grazing).
bioturbation	Biological perturbation, or reworking, of sediment by organisms, affecting the exchange of organic matter, oxygen, nutrients etc. between buried sediment and the sediment surface and overlying waters.
by-catch	"The catch of non-target species and undersized fish of target species." (CCW 200125). "The part of the catch that does not belong to the retained part of the target species of a fishery. … unmarketable component of target species, marketable species which were not aimed for, … accidental catches. The term is often used rather loosely" (Baretta-Bekker *et al ibid*)
contaminant	Anthropogenically synthesised chemicals (e.g. PCBs, biocides etc.) and anthropogenically elevated naturally occurring chemical components (e.g. heavy metals) that are toxic or otherwise detrimental to the physiological health or well-being of typical species.
degrade	(*degrade*: to lower in rank or grade, to lower in character, value or position or in complexity; *degraded*: declined in quality or standard. *Chambers Dictionary 1998*). In this document, the meaning of degrade is applied to damage or impairment resulting from such human action as has a detrimental outcome for features.
demersal	Living on or near the seabed.
detrimental	Causing damage or harm; damaging, disadvantageous
dioecious	Sexes separate, *i.e.* not hermaphrodite
epifauna (-flora, -biota)	Animals (fauna), plants (flora), organisms (biota) that live on top of seabed or other organisms, either attached to them or freely moving over then; *cf* infauna (*qv*)
eutrophic	Waters rich in mineral and organic nutrients that promote a proliferation of plant life, especially algae, which reduces the dissolved oxygen content and often causes the reduction or extinction of other organisms.
evolve	To alter with time, either remaining stable (qv) or changing

Term	Meaning as employed in this conservation advice
extent	The area a feature, or one of its components, covers within its natural range (qv) within the site.
factor	A circumstance, fact, influence or element that: • contributes to composition of a habitat, its structure, function or biology; • contributes to a result or to bringing about a result; • affects the course of events. *Many factors are processes (qv)*
functions	Functions are processes that may, directly or indirectly, influence: • the state of a physical habitat; • the marine life associated with that habitat.
habitat components	Contributing to the composition of a habitat. This includes physical and biological sub-habitats e.g. different types of reef, as well as different elements such as particular communities that make up reef habitats
halocline	The boundary zones between layers of seawater at different salinities (see also thermocline and oxyclines). Together with thermoclines, halocline have a strong influence on seawater density, circulation and species distribution
hydrodynamics	The mechanical effects of moving fluids; i.e. the motions of the sea. (Baretta-Bekker *et al ibid*)
hydrography	The description of the seas: 1) “marine cartography” (coastlines, bathymetry); 2) “descriptive oceanography” (the “description of water properties, their distribution and variation”; encompasses hydrodynamics qv) (Baretta-Bekker *et al ibid*)
hypertrophic	Waters in which mineral and organic nutrients are elevated above natural levels (cf eutrophic qv).
inherent	Existing in and inseparable from something else; innate; natural; the relation between a quality or attribute and its subject (Oxford English and Chambers Dictionaries)
inhibit	To hold in or back; to keep back; to restrain or check; to restrict or prevent
maerl	A calcareous red alga (seaweed) that is an important habitat-structuring component. Maerl is very slow growing and maerl beds tend to support particularly rich and biodiverse marine communities.
maximum sustainable yield (MSY)	Maximum use that a renewable resource can sustain without impairing its renewability through natural growth or replenishment. Fishing at MSY levels means catching the maximum proportion of a fish stock that can safely be removed from the stock while, at the same time, maintaining its capacity to produce maximum sustainable returns, in the long term. Considered as an international minimum standard for stock rebuilding strategies (i.e. stocks should be rebuilt to a level of biomass which could produce at least MSY).
mega, macro, and meio- (biota / flora / fauna)	The sizes of plants and animals. Mega-: no internationally agreed definition, but commonly defined as large enough to be seen discriminated in photographs, 2 cm or larger. Macro - large enough to be seen by the naked eye, greater than 0.5 mm, to up to 2cm. Meio-: organisms that cannot be observed without a microscope; organisms between 0.03 or 0.06 mm and 0.5 mm (cf micro-: organisms invisible to the naked eye, smaller than meiofauna; defined as <32µm) (*Multiple references*)
natural	In this document, the meaning of natural is taken to be as defined in standard English dictionaries: inherent, innate, self-sown and uncultivated, not the work of or the direct product of interference by human action; in accordance with nature; relating to or concerning nature; existing in or produced by nature; in conformity with nature; not artificial. It does not mean or imply pristine (i.e. an original, unmodified, state).
oxycline	The boundary zones between layers of seawater with different dissolved oxygen concentrations (see also halocline and thermocline). Strong influence on species distribution.
process	A series of actions, events or changes that vary in space and over time. In this context processes include physical, chemical and biological environmental changes which are inherently natural but which may be modified by human activity (e.g. wave action, nutrient fluxes).

Term	Meaning as employed in this conservation advice
	All processes are factors.
quality (of habitat)	The relative absence of anthropogenic modification of naturalness of habitat extent, structure, function and typical species as a result of, inter alia: • change in distribution, extent, geology, sedimentology, geomorphology, hydrography, meteorology, water and sediment chemistry and biological interactions; • change in species richness, population structure and dynamics, physiological health, reproductive capacity, recruitment, mobility and range or of anthropogenic modification of suitability of habitat as a result of, inter alia; • level of disturbance • alternation of prey/food supply • contamination of food supply
range	The natural spatial distribution of a feature, habitat, habitat component or species. Depending on the context, this term either describes the global distribution of the feature or, in the context of the site, the distribution of the feature within the site
safe biological limits	ICES definition of fisheries sustainability. “Within SBL” defined as stock at full reproductive capacity and harvested sustainably. ICES Advice Autumn 2004 & summarised at www.defra.gov.uk/environment/statistics/coastwaters/cwfishstock.htm
salinity	Seawater salinity is measured in parts of salt in one thousand parts water (‰).
salt wedge	When freshwater and seawater meet in an estuary or sheltered marine inlet, the two water masses or different density often do not mix completely. A distinguishable inflowing tongue of dense seawater beneath a less dense layer of freshwater is referred to as a salt wedge. The shape of the salt wedge in Milford Haven is measurably deflected to the south side of the Haven by the earth’s rotation.
sessile	Benthic (qv) organisms living attached to the seabed substrate.
species richness	Variety of species. The total number of species: • among a fixed number of individuals; • per unit of surface area (of habitat).
spraint	Descriptive term for otter faeces. Spraint has a distinctive smell and appearance; it contains indigestible food remains from which prey species may be identified.
stable	Tendency towards an equilibrium state in spite of varying external conditions.
structure	The composition and arrangement of those: • parts of the feature, • parts of the natural environment, • circumstances, that constitute the feature or are required by the feature for its maintenance in both the long term and foreseeable future.
stochastic	Random, chaotic, possible but unpredictable.
thermocline	A boundary zone between layers of seawater at different temperatures (see also halocline and oxycline). Together with haloclines, thermoclines have strong influences on seawater density, circulation and species distribution.
supporting sediments	Sediments with strong geomorphological / sediment-transport links to the feature. Particularly relevant to areas of sediment exchange and supply.
thermohaline circulation	Seawater circulation driven by density differences caused by seawater temperature and salinity differences.
typical species	Species that are, from time to time, associated with a specified habitat within the site; i.e. all species that contribute to the biodiversity of the specified habitat within the site.

Annex 3 List of SSSIs and SPAs partly or wholly with the SAC

Sites of Special Scientific Interest that are partly or wholly within the SAC:

- Aberarth – Carreg Wylan
- Caeau Crug Bychan, Ty Gwyn a Llwyn Ysgaw
- Afon Teifi

There are no SPAs that are partly or wholly within the SAC

Locations are shown on the associated feature map[66].

[66] All features are contained in one interactive PDF map available on the NRW website, details of data used in the maps can be found in Annex 1.

Annex 4 Elements of favourable conservation status

Elements that may be considered when assessing or considering favourable conservation status of a habitat or feature.

Table 4.1: Habitats – elements of favourable conservation status and its rationale

Element	Description and rationale
RANGE	
Distribution	Distribution of habitat features within the site, and also within a national and European context, has a key role in determining the distribution and abundance of typical species. Also important is the distribution within a habitat feature of components of habitat structure (e.g. Sediment granulometry) and of habitat function (e.g. Wave exposure).
Extent	Overall extent, large examples or extensive areas are inherently highly rated and contribute to conservation of structure and function The extents of habitat components, both structural functional are important determining factors of habitat and species diversity.
Structure	Physical structures of habitat features and their variation are the foundation of habitat diversity and, accordingly, species diversity. Along with environmental processes (function), habitat structure strongly influences where things live.
Geology	Geology at all spatial scales underpins the structure of the habitats, from overall coastal structure, which determine exposure to major environmental processes, to local habitat structure. The range of rock types and the distribution of rock folding, faulting and fracturing determine the overall complexity of shape of the seabed and coast and the diversity of habitats.
Sedimentology	Sedimentology is the result of complex processes significantly influenced by water movement. Sediment granulometry, structure and degree of sorting (from well sorted fine – medium sands and muddy sands to poorly sorted, mixed substrata containing mud, gravel, shell and stones) creates an extremely wide range of sediment habitats.
GEOMORPHOLOGY	
morphology (shape)	The gross shape of features and of individual sections of features is an essential component of habitat structure and contributes to habitat diversity.
topography (surface structure)	Surface relief of all substrates is a fundamentally important component of habitat structure, underpinning biological diversity through the provision of different habitats and microhabitats and a range of depths below sea level or intertidal drying heights. Topography, together with morphology, has a critical influence on hydrodynamic processes. Rock topography is fundamentally determined by geology. The range of rock topography is a particularly important contributor to reef biodiversity. Sediment topography is important in sediment habitats. For example granulometry and slope together determine sediment flats' ability to retain water during low tide (the amount of interstitial water retained is important in determining community composition); the breadth of the shore (related to slope) in combination with shore aspect, is important in determining the degree of wave energy expended on any part of the shore, therefore influencing community composition.
microtopography	Rock microtopography is determined by geology, with surface pits, cracks, fissures, bore-holes etc. providing additional niches for marine wildlife. The microtopography of sediment flats is important in determining water runoff (including the formation of rips) and retention and, in turn, influence the distribution of surface biota and granulometry.
orientation and aspect	Orientation and aspect are products of morphology and topography that, in combination with functional processes such as wave or light exposure, extend the variety of niches provided by habitat features. Range and variation in orientation and aspect enhance habitat and species diversity.
bathymetry	Bathymetry is determined by other structural components and by hydrodynamic and sediment processes. Depth of seabed is in turn a critical influence on hydrodynamic processes, such as wave exposure and tidal streams. In combination with water

Element	Description and rationale
	clarity, depth determines light attenuation through the water column thereby contributing directly to community structure. Bathymetric variation within and between individual parts of features enhances habitat and species diversity
FUNCTION	Distribution, extent, abundance and variety of species populations is shaped by spatial and temporal variation of a wide range of physico-chemical and biological processes (functions).
Hydrography & meteorology	Hydrographic & meteorological processes are fundamental to the structure and function of habitats and their species populations. The magnitude of hydrographic factors varies along gradients determined by the underlying geomorphology of the site and complex interactions with other functional processes.
hydrodynamics (water movement)	Water movement is a fundamentally important environmental process that determines the species composition present at any particular location, both directly and indirectly through its effect on other important processes such as nutrient, sediment and dissolved gas transport. The range of relative contributions of tidal streams, wave action and residual currents to water movement is particularly important in determining biological composition.
	Tidal range and rise - fall is of critical importance to structure, function and species population of habitats both directly – determining extent of intertidal areas and the emergence regime; and indirectly through the action of tidal streams.
	Tidal streams (currents): the strength, patterns, relative constancy, lack of attenuation with depth, general bidirectionality and spatial and temporal variations in tidal streams are important in structuring the distribution of species populations; food, sediment and chemical transport processes; water mixing.
	Wave exposure. Wave action is one of the most physically powerful, chaotic and relatively unpredictable processes. Exposure to wave action is determined by habitat morphology, topography, aspect, attenuation with depth and meteorological processes and has a major influence on distribution of species populations; water clarity and water mixing. The range of wave exposure within the site is extreme.
	Residual current flows modify local hydrodynamic and meteorological processes for example through inputs of water masses with elevated suspended sediment loads, temperature and / or nutrients and contaminants.
temperature (water)	Water temperature strongly influences water chemistry and biological processes, such as reproduction and metabolism. The biogeographical location of the sites and the degree of buffering of winter minima and summer coastal warming by oceanic waters (North Atlantic Drift) strongly influences and limits the sea temperature range. Temperature range is important in mediating reproduction and survival of species, shielding submerged species from the more extreme temperatures experienced by intertidal species and reducing the ability of some non-native species to become established. Global processes (global warming, shifts in ocean currents), influenced by climate change, also influence local seawater temperature regime temporarily, seasonally or chronically.
light intensity (ambient seabed and water column)	Seabed light intensity has an important influence on community structure, particularly through algal species distribution, mediated by bathymetry, water transparency and localised shading (e.g. from overhangs, caves or aspect). Spatial and temporal variation in light intensity has considerable broad and local scale impacts on species population distributions and community variation. Water column light intensity in combination with shelter from extreme water movement and elevated nutrients is important in the occurrence and distribution of seasonal plankton blooms.
Seston Concentrations and water transparency (clarity/ turbidity)	Seston (suspended particulate matter) concentrations are critically importance as a food-energy resource, is a factor in sediment processes and deposition including smothering and scouring of biota, and through absorption of light modifying light availability at seabed and in water column. Seston composition and water column loads are determined by the origins of the particulate matter – biological productivity and / or riverine, coastal or oceanic water inputs.

Element	Description and rationale
METEOROLOGY	
temperature (air)	Air temperature is an important factor in several aspects of intertidal habitat function (heat / cold tolerance, control of reproduction, desiccation, dissolved oxygen, salinity). Although overall air temperature is climate controlled, it is subject to local modifications by habitat structure and species populations.
light (solar irradiance)	Solar irradiance is a fundamental requirement for plant primary production. It is determined by meteorological conditions, and seabed and water column irradiance is mediated as described above. It also has direct effects on temperature, desiccation, UV exposure, dissolved oxygen and salinity in intertidal habitats, where it is mediated by localised shading (e.g. from overhangs, caves or aspect).
humidity	In association with temperature and air movement, humidity is an important factor controlling evaporation, and consequently salinity and the desiccation of intertidal species. Although overall humidity is climate controlled, it is subject to local modifications by habitat structure and species populations.
air movement (wind)	Wind strength, direction and fetch are the fundamental influences on wave action. The effect of air temperature and humidity on intertidal species and communities is strongly influenced by air movement. Although overall air movement is climate controlled, it is subject to local modification by habitat structure and local topography.
precipitation	Rainfall locally modifies salinity in intertidal areas, modifies temperature and humidity and increases transport of terrestrial sediments and other materials (e.g. nutrients, contaminants) into the marine environment. Land use and surface water management influences the effect of heavy rainfall in creating spate events that increase short term flow rates, soil erosion and particulate suspension.
WATER & SEDIMENT CHEMISTRY	
salinity	Salinity is of fundamental physiological and ecological significance. Horizontal and vertical salinity gradients from average fully saline open coast seawater through brackish to freshwater and temporal variation in the gradients are of primary importance in species distribution.
nutrients	Dissolved organic nutrients and trace elements are essential to biochemical processes. Major nutrients in unmodified conditions vary seasonally within ranges characteristic of individual water bodies with the uptake by and decomposition of biota. Acute or chronic anthropogenic elevation causes ecologically important eutrophication or toxic effects.
contaminants	Levels of acutely or chronically toxic anthropogenically synthesised chemicals (e.g. PCBs, biocides etc.) and anthropogenic elevation of naturally occurring chemical components (e.g. some hydrocarbons, heavy metals) are critical influences for example on species survival, physiological health, and reproductive capacity.
dissolved oxygen	Oxygen availability is of fundamental physiological and ecological significance. Availability is influenced by water movement and surface disturbance, water temperature, sediment granulometry and disturbance, organic content and biological oxygen demand. Reduced oxygen flow and / or increased oxygen demand (through decomposition of trapped organic matter) within sediments tends to result in significantly reduced levels; anaerobic conditions in sediments may result in the formation of toxic substances (e.g. hydrogen sulphide).
sediment processes	Sediment erosion, transport and deposition are critical in determining extent, morphology and functional processes of sediment based habitats and have important functional influences on rock-based habitats. Sediment processes in the site are a reflection of many complex causal processes and are themselves complex, contributing to high habitat and community diversity.
TYPICAL SPECIES	As the rationale for selection of components of species conservation status is similar for both species features and typical species of habitat features the rationale for both has been combined and is given the species table below.

Table 4.2: Typical species & species features – elements of favourable conservation status and its rationale.

Element	Description and rationale
SPECIES RICHNESS (Variety of species)	Species richness is most likely to be applicable as a component of FCS for typical species of Habitat features. However, the variety of available prey is likely to be important to predatory species features such as dolphins, seals, otter, lamprey and shad, and, as such, it forms an important measure of a species features habitat quality. Biological variety is a key contributor to biodiversity and applies at both taxonomic and genetic levels. Species variety "typical" of different habitats is dependent on the ecological opportunities available (niche diversity), particularly the degree of stress from natural processes. Habitats and communities subject to moderate levels of disturbance tend toward high species diversity. A high proportion of the species in such highly diverse communities are usually present at low frequencies and, individually, may make a small contribution to the overall functioning of the community. Nevertheless, such "species redundancy" is a vital contribution to biodiversity in many marine habitats and communities, and is consequently extremely important in terms of the conservation of the habitat features.
POPULATION DYNAMICS	Species population dynamics are inherently important in maintaining viability of species populations and species variety.
POPULATION SIZE	
Population size (species abundance)	Sizes of species populations vary widely depending on their biology and ecology (e.g. Reproductive, competitive, survival and life history strategies; recruitment, habitat requirements; adaptation to natural processes and factors) and stochastic events. For a species feature, population size is a key measure of the species ecological success or failure. Along with a typical species' distribution, its population size determines its contribution to biodiversity and to habitat structure and function. Population sizes of small, short-lived, rapidly reproducing species are orders of magnitude greater than large, long-lived, slowly reproducing and infrequently recruiting species. Populations of many species fluctuate widely in response to natural and artificial perturbations and opportunities; many others remain stable for long periods and many of these are particular sensitive to anthropogenic disturbance or habitat degradation.
Contribution to the integrity of wider population	The full range of some species features are only partly encompassed by the site. The long-term viability of the species population may therefore be in part or mainly determined by stock outside the site, and vice versa (e.g. through immigration and emigration, genetic variation etc.). The contribution a species population occurring within a site makes to the wider population status is important to the long-term viability of the species as a whole, including that occurring within the site.
Biomass	Biomass is the potential energy of species populations, and thus fundamental to species physiological health, reproductive capacity and energy reserves, and is an energy resource for other species. Sediments with high organic input typically support a species biomass and rate of turnover (productivity) sufficiently high to contribute significantly to the maintenance of predatory typical species such as fish and waders and wildfowl. However, high biomass and low species variety may also be indicative of environmental stress or perturbation. Biomass of different reef habitats is extremely variable, varying with species composition and recruitment, age structure, health and environmental stress and consequently frequently varies widely within a small area of apparently similar habitat for a variety of reasons.
Reproductive success	The ability to successfully reproduce is critical to a species population's long-term viability. Reproductive success is a function of reproductive capability and the survival of young. Reproductive capability is a function of many factors including physiological health, temperature regime and population density. Reduced physiological health and other

Element	Description and rationale
	stressors can reduce reproductive capability as, under these circumstances, most species concentrate internal resources on survival instead of reproduction. For many species (not mammals and birds) gonadal somatic index (ratio between body mass and gonad mass) is a good measure of reproductive capability. High reproductive capability does not necessarily translate to high reproductive success. Survival of young to age of recruitment to the population is a function of reproductive strategy and varies by orders of magnitude depending on the strategy, ecological hazards and stochastic events. Dispersive invertebrate larval stages vary extremely in the numbers surviving from place to place and time to time with weather, currents, availability of food, period spent in the plankton, predation and intrinsic variability in processes killing and removing species e.g. competition for food and space, predation. At the other extreme, survival of young marine mammals is very high because of the heavy parental investment in low numbers of offspring. However, the relative survival rates of all strategies are vulnerable to modification by stochastic events.
Recruitment	Recruitment of young is critical to the maintenance of species population's long-term viability. Natural variation in successful recruitment is a critical factor contributing to species variety. Many invertebrate and algal species are at least partly dependant on recruitment from outside the feature.
POPULATION STRUCTURE	
Age frequency	Age frequency is important in determining the degree of success of population reproduction and resilience to perturbation for many species. Variation in population structure contributes to the complexity of community mosaics and to biodiversity. Age or size frequency is an important indicator of a species population's long-term viability.
Sex ratio	Sex ratio is important in determining the degree of reproductive success and therefore the long-term viability of dioecious species populations.
Physiological health	Physiological health is a critical component of a species population's long-term viability. It encompasses both genetic and physiological fitness. Knowledge of the physiology of most marine species is inadequate to directly express health in positive terms. Indicators of healthiness include reproductive capacity (e.g. gonadal somatic index) and immunity to disease; and of potential poor health: contaminant burden, immunosuppression, epibiota burden, nutritional state and physical damage.
Immunity to endemic disease	Reduced physiological health, e.g. through raised stress or chemical contamination, typically increases susceptibility to endemic diseases.
Exposure to anthropogenic disease	Certain species may contract diseases of humans and domesticated animals. Certain anthropogenic activity can increase the risk of this. Whilst diseases that can cross such species barriers are few, if it were to occur there is the potential for very significant impact on the wild species population.
RANGE	
Distribution throughout site	Species populations are distributed within their habitats according to their ecological requirements (particularly sessile species). The distribution of most species across and along environmental gradients results in extremely complex mosaic of communities (aggregations of species) that vary over time. The distribution and extent of species are, within constraints of species' adaptation to physical factors and biological interaction, variable in time and space. Modification of structural and functional factors by human action will likely result in alterations to species distribution, extent and abundance.
Distribution of specific behaviours throughout the site	Some mobile species (e.g. dolphins, seals, spider crabs & bass) use different parts of their habitat for different behavioural purposes (e.g. feeding, moulting, breeding). The locations used are usually important for the particular behaviour displayed. Displacement of this behaviour to other less favourable locations can be detrimental to the species.
Mobility (ability to move about the site, within and between features,	For most non-sessile species the ability to move around unimpeded is a prerequisite to maintenance of viable populations through, inter alia, successful feeding, predation-avoidance and reproduction. This includes both territorial species with localised mobility requirement and highly mobile and / or migratory species which are dependent on features for a part of

Element	Description and rationale
unimpeded)	their ecological requirements (inter alia otter, seals, sea and river lamprey, shad, herring). Unimpeded mobility of reproductive products, larvae and juveniles of species is critical to the maintenance of viable species populations.
SUPPORTING HABITAT & SPECIES	Any components of habitat conservation status (Table 4.1 above) may apply to typical species of habitat features, and may apply to a species feature where the component is relevant to the conservation of that species feature. The most likely components of habitat conservation status that are relevant to the conservation of species features are given below.
DISTRIBUTION AND EXTENT	
Preferred habitat	The habitat used by the species within the site. For wide ranging species this will likely be the whole area of the site.
Habitats utilised for specific behaviours	The distribution and extent of habitat necessary for specific behaviours, such as feeding, breeding, resting and social behaviour.
STRUCTURE & FUNCTION	
Structural and functional integrity of preferred and specific habitats	The structure and functions that maintain the habitat in a form suitable for the long-term maintenance of the species population. This is linked to habitat quality.
Quality of habitat	The natural quality of habitat features may be reduced by modification of structural components identified above and, including by: • the presence and persistence of artificial inert or toxic materials (e.g. synthetic plastics and fibres, hydrocarbons) • causing entanglement, smothering or ill-health; • decrease in seclusion because of noise and visual disturbance. Human activity with the potential to cause disturbance, • affecting behaviour or survival potential includes waterborne leisure and commercial activities, wildlife watching; • competition for space, causing displacement, collision, noise and visual disturbance, increased density dependent • pressure on preferred sites, exposure to disease (see above); • Contamination of prey (see below);
Prey availability	The presence and abundance of prey within the site may contribute to the species presence and its long term viability.
Prey contamination	Contamination of species feature prey can reduce the long-term viability of the species population. Contaminants that bioaccumulate and biomagnify and which affect the species physiological health would be of particular concern.

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