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Carmarthen Bay and Estuaries/Bae Caerfyrddin ac Aberoedd European Marine Site

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

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Summary

This document contains Natural Resources Wales's advice issued under Regulation 37 of the Conservation Regulations 2017, for the *Carmarthen Bay and Estuaries 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 summarises 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 *Carmarthen Bay and Estuaries SAC, Carmarthen Bay SPA and Burry Inlet SPA and Ramsar site*, 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 *Carmarthen Bay and Estuaries 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 designated as a SAC or SPA. 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 sites 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 sites 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	Link to Conservation Objectives
Carmarthen Bay & Estuaries SAC	<p>Habitats:</p> <ul style="list-style-type: none"> • Large shallow inlets and bays • Sandbanks which are slightly covered by seawater all the time • Estuaries • Mudflats and sandflats not covered by seawater at low tide • Atlantic salt meadows • <i>Salicornia</i> and other annuals colonising mud and sand 	<p>Conservation objectives</p>
	<p>Species:</p> <ul style="list-style-type: none"> • Otter <i>Lutra lutra</i> • Allis shad <i>Alosa alosa</i> • Twaite shad <i>Alosa fallax</i> • River lamprey <i>Lampetra fluviatilis</i> • Sea lamprey <i>Petromyzon marinus</i> 	
Burry Inlet and Carmarthen Bay SPAs	<p><u>Burry Inlet SPA</u></p> <ul style="list-style-type: none"> • Curlew <i>Numenius arquata</i> • Dunlin <i>Calidris alpina</i> • Grey plover <i>Pluvialis squatarola</i> • Knot <i>Calidris canutus</i> • Oystercatcher <i>Haematopus ostralegus</i> • Pintail <i>Anas acuta</i> • Redshank <i>Tringa totanus</i> • Shelduck <i>Tadorna tadorna</i> • Shoveler <i>Anas clypeata</i> • Teal <i>Anas crecca</i> • Turnstone <i>Arenaria interpres</i> • Wigeon <i>Anas penelope</i> <p><u>Carmarthen Bay SPA</u></p> <ul style="list-style-type: none"> • Common scoter <i>Melanitta nigra</i> 	<p>Conservation objectives</p>

Crynodeb

Mae'r ddogfen hon yn cynnwys cyngor gan CNC a roddwyd dan Rheoliad 37 Rheoliadau Cadwraeth 2017, ar gyfer *Ardal Cadwraeth Arbennig Bae Caerfyrddin ac Aberoedd*, 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 diweddarau'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 hygrych, ond ni chyflwynir unrhyw newid o ran yr hyn a ystyrir fel Statws Cadwraethol Ffafirol.

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 deallir 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 Caerfyrddin ac Aberoedd* 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 Caerfyrddin ac Aberoedd* fel ACA, 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 Caerfyrddin ac Aberoedd ACA	<p>Cynefinoedd:</p> <ul style="list-style-type: none"> • Cilfachau a baeau mawr bas • Ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser • Aberoedd • Gwastadeddau llaid neu dywod nas gorchuddir gan y môr ar lanw isel • Dolydd ar forfeydd arfordir y gorllewin • <i>Salicornia</i> a phlanhigion unflwydd eraill sy'n cytrefu llaid a thywod 	Amcanion Cadwraethol
Burry Inlet ac Bae Caerfyrddin AGA	<p>Rhywogaethau:</p> <ul style="list-style-type: none"> • Dyfrgi <i>Lutra lutra</i> • Herlyn <i>Alosa alosa</i> • Gwangen <i>Alosa fallax</i> • Lamprai neu lisywen bendoll yr afon <i>Lampetra fluviatilis</i> • Lamprai neu lisywen bendoll y môr <i>Petromyzon marinus</i> <p><u>Burry Inlet AGA</u></p> <ul style="list-style-type: none"> • Gylfinir <i>Numenius arquata</i> • Pibydd y mawn <i>Calidris alpina</i> • Cwtiad llwyd <i>Pluvialis squatarola</i> • Pibydd yr aber <i>Calidris canutus</i> • Pioden fôr <i>Haematopus ostralegus</i> • Hwiyaden lostfain <i>Anas acuta</i> • Pibydd coesgoch <i>Tringa totanus</i> • Hwyaidd yr eithin <i>Tadorna tadorna</i> • Hwiyaden lydanbig <i>Anas clypeata</i> • Corhwiyaden <i>Anas crecca</i> • Cwtaid y traeth <i>Arenaria interpres</i> • Chwiwell <i>Anas penelope</i> <p><u>Bae Caerfyrddin AGA</u></p> <ul style="list-style-type: none"> • Môr-hwiyaden ddu <i>Melanitta nigra</i> 	Conservation objectives

1. Introduction

The 1992 EC Habitats Directive¹ 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 authorities³ 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 Carmarthen Bay and Estuaries 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 sites comprising the Carmarthen Bay and Estuaries 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/ukxi/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 5 (conservation objectives) and 6 (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 long-term 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 Commission⁵ 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 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 monitoring⁸ and allows judgements to be made

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

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

about site condition⁹ and conservation status of features for purposes such as reporting and review of management.

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. Surveillance¹⁰ 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/evenness, population dynamics and range 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

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.

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>)

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 Committee¹¹.

2.2 Operations which may cause deterioration or disturbance

3.2.1 Legal context

NRW's specific duty in Regulation 37 is 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 management¹². 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.

3.2.2 Practical Requirements

Operations manifest themselves through one or more factors¹³. 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 operation¹⁴. 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.

¹¹ <http://jncc.defra.gov.uk/sacselection>

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)

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.
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 consent¹⁶. 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 Description

Carmarthen Bay EMS consists of three sites, the Carmarthen Bay and Estuaries SAC and two Special Protection Areas which occur within the SAC; Carmarthen Bay SPA, and Burry Inlet SPA and Ramsar site (See feature map¹⁷).

3.1 Carmarthen Bay Estuaries SAC

The Carmarthen Bay and Estuaries SAC is a large site encompassing the estuaries of the Rivers Loughor, Tâf and Tywi (coastal plain estuaries) and the Gwendraeth (a bar-built estuary) (see feature map). There are extensive areas of intertidal mudflats and sandflats with large areas of these flats dominated by bivalves. There is a complete sequence of saltmarsh vegetation, from pioneer vegetation through to upper saltmarsh transitions and it is also important for transitions from saltmarsh to sand dune and other habitats.

Carmarthen Bay is an extensive shallow bay with a wide variety of seabed types, including mud, sand and rock, although the majority of the seabed is sandy. The SAC includes Helwick Bank, a linear shallow subtidal sandbank that is unusual in being highly exposed to wave and tidal action. The Burry Inlet and Three Rivers system provides a migratory route for salmonids, lampreys and shad.

The Carmarthen Bay and Estuaries SAC is a multiple interest site which has been selected for the presence of ten 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:

- Estuaries
- Mudflats and sandflats not covered by seawater at low tide
- Atlantic saltmeadows (*Glauco-Puccinellietalia maritimae*)
- *Salicornia* and other annuals colonising mud and sand
- Large shallow inlets and bays
- Sandbanks which are slightly covered by sea water all the time
- *Alosa* sp. – shad

and to support a significant presence of:

- *Lampetra fluviatilis* – river lamprey
- *Petromyzon marinus* – sea lamprey
- *Lutra lutra* - otter

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. The latter includes indicative data as the extent of most features is not known precisely and some, such as sandbanks, are dynamic and can be highly mobile.

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. Maps showing the distribution of the habitats may be indicative

¹⁷ 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.

and the feature descriptions are provided on the basis of current knowledge and may be subject to change as knowledge improves.

3.2 Site Description

The Carmarthen Bay & Estuaries SAC encompasses areas of sea, coast and estuary that support a wide range of different marine habitats and wildlife, some of which are unique in Wales.

In places the SAC landward boundary abuts the boundary of SACs encompassing terrestrial / coastal habitats and species and some intertidal areas that are part of the marine SAC have been notified as Sites of Special Scientific Interest (SSSI) (see Annex II). The health of adjacent areas such as the Carmarthen Bay Dunes SAC is intimately linked with that of the estuaries and intertidal areas. The Carmarthen Bay SAC also overlaps wholly or in part with the Burry Inlet and the Carmarthen Bay Special Protection Areas classified under the Birds Directive. The location of these SACs, SPAs and SSSIs are shown in the feature map. Carmarthen Bay is also a Geological Conservation Review site for its Coastal Geomorphology.

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

a) Range

The Carmarthen Bay & Estuaries SAC covers an area from St. Catherine's Island in the east to just west of Oxwich encompassing the Three Rivers area (Rivers Taf, Tywi and Gwendraeth), the Burry Inlet and Loughor Estuary, and the northern and western parts of the Gower peninsula. It extends out into Carmarthen Bay and includes the Helwick Bank which lies within the Bristol Channel.

The features for which the site was selected are distributed throughout the SAC, with no single feature occupying the entire SAC and with some features overlapping in certain locations.

b) Structure

i. Geology

Carmarthen Bay was created primarily by the underlying geological features and then infilled with the prevailing mobile substrata and modified by the hydrographic regime. The Bay is underlain and partially bound by Carboniferous and Devonian limestones and sandstones. There are small areas of natural hard substrata in the intertidal zone including bedrock (Wharley Point), scars of cobbles and boulders (Wharley Point, Ferryside, Salmon Point Scar, Whiteford) and mussel beds on cobbles (Salmon Point Scar, Ginst Point, Whiteford Point), but these are poorly represented compared with other inlets in Wales.

ii. Sedimentology

The shores of South Beach (Tenby), Waterwynch Bay, Monkstone beach and Cefn Sidan sands, between the Three River system and the Burry Inlet, are mainly mobile fine and medium sands while the mudflats and sandflats of the Three Rivers system and that of the Burry Inlet and River Loughor are mostly sandy gravel or muddy sand. Sheltered sandy gravel shores are found from the edge of Pendine Sands, stretching around into the mouth of the Three Rivers system, where a variety of different sediment types are found. The

mouth of the Three Rivers system is dominated by moderately mobile fine sands that are continually shifted by waves and tidal action and Mid-Flandrian peats are present intertidally and subtidally in this system.

Sediment types range from mobile fine and medium sands, muddy sands, sandy and silty muds, and pure muds, to limited areas of exposed immobilised sandy and / or muddy gravel pavements of glacial provenance. There is a gradation within the distribution of sediments, from mud in the upper, more sheltered regions of the estuaries, to sand at the more wave-exposed mouths of the estuaries. Inputs of fine sediments from rivers into all of the estuaries are small, compared to other sources such as inward migration from the sea.

The seabed sediments of the Helwick Bank area are predominantly uniform, medium fine sands with little or no fine or organic material. The more landward side of Helwick Bank is comprised of finer sands. To the south of the Bank, in deeper water, there are some uniform gravelly sands with no bedforms, as well as irregular sand patches on gravel.

iii Geomorphology

Carmarthen Bay is an excellent example of a coastline whose outline was moulded by marine and sub-aerial processes throughout the Quaternary period, but where the shoreline and its detail is much more recent in origin. The modern shoreline is a very dynamic one, as a result of the growth of spits, dune and saltmarsh development, changes in intertidal and deeper water bathymetry and erosion of both beaches and cliffs (Geological Conservation Review). There are four estuaries in the SAC formed by the rivers Tywi, Taf, Gwendraeth and Loughor. They form a single functional unit with important interchanges of sediment and biota especially within the 'Three Rivers' which converge and exit into Carmarthen Bay through a common mouth. There has been considerable sedimentation in the Three Rivers and Burry Inlet during and since the rise in sea level in the post-glacial era. The intertidal and subtidal sediments are thought to be derived largely from Carmarthen Bay.

The mudflats and sandflats range from narrow beaches to very expansive areas of gently sloping, almost horizontal, flats, to steeply inclined levees. Many of the saltmarshes are dissected by small creeks and channels, which provide microhabitats within more uniform areas of marsh. Saltpans and small pools add diversity to the site and are an intrinsic part of many marshes. An important feature of the site is the undisturbed transition to coastal habitats in some areas. The marshes on the southern side of the Burry Inlet between Whiteford Point and Loughor in particular are of national significance in respect of a variety of geomorphological features.

Helwick sandbank is located in open water to the south of Worm's Head off the Gower Peninsula. The feature is a linear, very shallow, subtidal sandbank that is one of the most highly exposed to wave and tidal action of the Welsh sandbanks.

c) Function

i. Hydrography and meteorology

The SAC is characterised by largely mixed, variable salinity water typical of macrotidal estuaries, and in Carmarthen Bay salinity varies from low to fully marine. During spring tides the tidal range is around 7.5 m at Burry Port, whereas during neap tides it is around 3.6 m. At Ferryside on the Tywi the tidal range at spring tides is 6.6 m and 2.7 m during neap tides. The tidal range decreases up the estuary and the bathymetry of the Loughor

Estuary causes a lag time in the progression of the flood tide up the estuary. In the Burry the tidal wave is symmetrical near the mouth but increasingly asymmetrical away from the mouth with the ebb becoming increasingly longer than the flood tide. This results in greater velocities on the flood than the ebb which affects sediment transport. The shallow gradients within the estuary result in large areas of intertidal flats and saltmarsh within the estuary.

ii. Water & sediment chemistry

Available nitrogen and phosphorus levels are in excess of the criterion indicating hypereutrophication in the upper estuary which has been linked to high numbers of algal cells and chlorophyll *a* concentrations. In addition, there have been inputs of heavy metals from industry and redundant coalmines in the estuaries. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales¹⁸.

iii Sediment processes

Within the estuaries the extensive sandflats above the mid-shore are fairly stable and flat. Below this the sandflats up to and beyond Loughor bridge are very mobile with large sandwaves and ripples. Sandbanks in the entrance are particularly mobile.

d) Typical species

A variety of intertidal and sublittoral biotopes are present reflecting the range of physiographic conditions. The estuaries of this site support a range of subtidal and intertidal sediments that grade from sand at the mouth to mudflats in the upper estuary. The fauna of the sediments varies, but includes communities with polychaete and oligochaete worms and areas with extensive cockle beds. The populations of the cockle *Cerastoderma edule* in the Burry Inlet and the Three Rivers are very large compared with other similar estuaries such as the Taw/Torridge and Camel.

The intertidal rock biotopes are subject to sand scour resulting in low species diversity but support barnacles and mussels as well as brown seaweeds on more sheltered cobble areas. Some areas of soft sediment, such as in the Burry Inlet support marine communities characterised by the dwarf seagrass *Zostera noltii*. Seagrass stabilises the sediment and is an important source of organic matter as well as providing shelter and surface for attachment by other species and food for wildfowl. The intertidal soft sediment coastline of Carmarthen Bay is characterised by extensive and substantial strandlines with a wealth of invertebrate fauna.

Subtidal habitats are of limited extent due to the estuaries largely draining at low tide. The mobile, sandy sediments are characterised by the presence of low numbers of amphipods, isopods and robust, mobile polychaetes. Species found on the Helwick Bank are mostly characteristic of mobile sands and gravels.

The estuary systems have exceptionally well developed saltmarsh to sand dune transitions, with a complete sequence of saltmarsh vegetation, including transitions to upper saltmeadow and to important sand dune habitats.

¹⁸ <http://waterwatchwales.naturalresourceswales.gov.uk/en/> relevant waterbodies for this site include: 3 rivers (Tywi, Gwynn & Gwendraeth), Loughnor, Loughnor Outer & Carmarthen Bay.

3.3 Burry Inlet SPA and Ramsar site

In 1992 the Burry Inlet was recommended as a Special Protection Area under the Birds Directive (79/409/EEC) because of the site's European ornithological interest. The site qualifies under Article 4.2 of the Directive as it is used regularly by 1% or more of the biogeographic population of regularly occurring migratory species: knot *Calidris canutus*, oystercatcher *Haematopus ostralegus*, pintail *Anas acuta*, and redshank *Tringa totanus*.

The area qualifies under Article 4.2 of the Directive by regularly supporting at least 20,000 waterfowl, including: curlew *Numenius arquata*, dunlin *Calidris alpina alpina*, grey plover *Pluvialis squatarola*, shelduck *Tadorna tadorna*, shoveler *Anas clypeata*, teal *Anas crecca*, turnstone *Arenaria interpres*, and wigeon *Anas penelope*¹⁹.

The *Burry Inlet SPA* regularly supports large numbers of overwintering wildfowl and waders that feed in the saltmarshes and on the intertidal areas. The site is the most important wholly Welsh estuary for overwintering waterfowl and is particularly significant for oystercatcher.

- The site is used regularly by at least 1.5 % of the biogeographic population of migratory and overwintering oystercatcher. The 5 year peak mean for 1991/92-1995/96 was 13,590 individuals.
- The site is used regularly by at least 3.0 % of the biogeographic population of migratory and overwintering pintail. The 5 year peak mean for 1991/92-1995/96 was 1,772 individuals.
- The Burry Inlet SPA is used regularly by at least 0.6 % of the biogeographic population of migratory and overwintering knot. The 5 year peak mean for 1991/92-1995/96 was 2,153 individuals.
- The Burry Inlet SPA is used regularly by at least 0.3 % of the biogeographic population of migratory and overwintering redshank. The 5 year peak mean for 1991/92-1995/96 was 616 individuals.

A 5 year mean peak count in excess of 34,960 waterfowl has been recorded (30/06/1999). Waterfowl assemblage species include curlew, dunlin grey plover knot, oystercatcher, pintail, redshank, shelduck, shoveler, teal, turnstone, and wigeon.

The Burry Inlet is a large estuarine complex that it includes extensive areas of intertidal sand- and mudflats, together with large sand dune systems at the mouth of the estuary. The site contains the largest continuous area of saltmarsh in Wales (2,200 ha). The estuary experiences wide tidal fluctuations (about 8 m), which has the consequence of exposing a large extent of intertidal sediments on a regular basis. These are mostly sandy, but muddy substrates are to be found in more sheltered areas. The plethora of habitats provides for important feeding grounds and resting areas. In places, the extensive mud and sandflats support substantial populations of marine invertebrate species, which provide an important food source for the large numbers of overwintering waterfowl found there.

¹⁹ NRW's advice focuses on the qualifying species for which the SPA was originally classified in 1992, despite the fact that numbers and species composition may have changed on this site since that time. Such population and species composition changes have been documented through the UK SPA Network Review, led by JNCC, which will provide advice to Ministers on any changes in SPA citations required. Depending on the outcome of this review and decisions from DETR and the Welsh Assembly Government, NRW may need to reissue this advice with updated bird information required.

Specialist feeders such as oystercatcher and knot that feed mainly on shellfish (cockle *Cerastoderma edulis* and mussel *Mytilus edulis*) outside the breeding season can be vulnerable if in competition with the commercial exploitation of these resources. There is a well-established NRW managed cockle fishery and Welsh Government managed seed mussel fishery in the site. Unregulated adult mussel fisheries also occur on the site.

3.4 Carmarthen Bay SPA

Carmarthen Bay SPA was the first fully marine SPA in the UK. . The site was classified in June 2003, qualifying under Article 4.2 of the Birds Directive (79/409/EEC), solely for wintering common scoter *Melanitta nigra*, as it is used regularly by at least 1.1 % of the biogeographic population. Carmarthen Bay is one of the most important individual wintering site in Britain and Ireland for this species Non-qualifying species of interest are red throated diver *Gavia stellata*, velvet scoter *Melanitta fusca*, eider *Somateria mollissima*, Manx shearwater *Puffinus puffinus*.

The distribution of common scoters within the bay varies spatially and temporally, but birds are generally found throughout a band approximately 5 km wide running from the north-west of the bay off Amroth and Saundersfoot to the east off Pembrey Sands, where the seabed is at 10 m depth or less. During the period following the *Sea Empress* oil spill, deeper waters in the south-east of the bay (Rhossili Bay) were used by the birds to a greater extent²⁰.

The condition of the feature of the SPA is assessed against the five-year peak mean value. This allows for inter-annual variation and is based on the average of the peak count for five winters (i.e. 2008/09 – 2012/13). The 5-year peak mean for 1997/98 to 2001/02 was 16,946 individuals.

Survey data from 1995 to present day show that Carmarthen Bay is regularly used by large numbers of common scoter. Digital aerial survey results from February 2013 produced a common scoter population estimate of 24,383 individuals (with lower and upper 95% confidence limits of 19,869 and 29,197 respectively). Precision surrounding the estimate was a Coefficient of variation (CV) of 0.01, reasserting the reliability of the grid-based digital aerial survey method²¹.

Common scoter return to Carmarthen Bay in late July to early September. There are two peaks, the first in August/September as birds arrive either straight from breeding grounds or from other staging areas, when birds may moult at the site, the second (normally providing the largest annual numbers) occurring in December to January²². Numbers then fall as common scoter start their spring migration to breeding grounds. Spatial distribution of birds throughout Carmarthen Bay also change through the year. In late summer, Cefn Sidan and Pembrey are both very important sites in terms of numbers of scoter, but through the rest of the year Pendine to Amroth is the most favoured area. Lovegrove²³ reported the preferred areas to be Cefn Sidan / Burry Inlet throughout the season. Whether this is due to genuine changes in distribution of overwintering flocks or to bias in the

²⁰ Cranswick *et al.* (1998)

²¹ APEM (2013)

²² Banks *et al.* (2008)

²³ Lovegrove (1977)

sampling method is hard to assess. There is probably much movement between sites, and changes in favoured sites, especially from year to year.

The ratio of males to females changes through the season. In late summer there is a strong dominance of males; ratios greater than 9:1 have been recorded as males head south from breeding grounds before females. The number of females increases through to mid-winter when there can be 65 % females and immature birds.

Common scoters are most often observed in inshore waters of less than 20 m in depth due to the energetic costs of diving to the seabed to forage for benthic prey²⁴. Water depth is therefore a critical parameter for common scoters and their distribution may shift according to tidal state and prey availability. Aerial surveys of Liverpool Bay have shown that overwintering common scoters do utilise sea space beyond the range of telescopic observations and can occur in water up to 25 m depth. Feeding areas (based on distribution and abundance of prey species) of the common scoter in Carmarthen Bay have been identified. Preferred foraging areas lie in an area starting at Monkstone Point in the west, stretching off Saundersfoot and Amroth, to Pendine Sands in the east, and range in depth between 2 and 5 metres. A smaller number of birds have also been recorded in deeper water (12 to 16 m) off Rhossili Bay / Worm's Head.

Common Scoters are diving ducks that feed on prey species that live upon or within the upper few centimetres of the substratum. The diet of common scoter is thought to comprise mainly bivalve molluscs, other species are incorporated less frequently (e.g. crabs, small fishes and gastropods), and echinoderms seem to be included in the diet at such a low frequency that they are presumed to be ingested incidentally²⁵. Common Scoter feed on benthic prey whose life-history strategies and productivity are intimately linked to the sedimentary and coastal environment²⁶.

In Carmarthen Bay, the largest and most widespread group of benthic invertebrates is characterised by the polychaetes *Spiophanes bombyx*, *Magelona filiformis* and *Chaetozone setosa*, the bivalves *Fabulina fabula*, *Kurtiella bidentata* and *Chamelea gallina*, and the amphipod *Bathyporeia tenuipes*. This group is classified as belonging to the *Tellina* sub-community of the shallow *Venus* community with the main biotope being "Sublittoral sand and non-cohesive muddy sand, *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves in infralittoral compacted fine sand".

3.5 Operations within the EMS

The area surrounding Carmarthen Bay and its estuaries is predominantly rural with a relatively small and steadily declining heavy industry centred at Llanelli. The site and surrounding coastline is heavily used for a wide range of commercial and recreational activities. The major coastal settlements include Tenby, Burry Port, Llanelli, Loughor and West Swansea, with Tenby, Saundersfoot and Pendine being tourism hotspots. The coastal settlements give rise to localised pressures on the marine environment.

Extensive reclamation of saltmarshes, undertaken chiefly in the 19th century, has taken place along the southern shoreline of the Burry Inlet and along the Taf Estuary. Sea

²⁴ Kaiser *et al.* (2006); Banks *et al.* (2008)

²⁵ Vaitkus & Bubinas (2001), Kaiser *et al.* (2006)

²⁶ Snelgrove & Butman (1994)

defences, including sea walls, rock armour, gabions and groynes, now bound significant stretches of the bay and its estuaries. In addition, protection of coastal railway tracks that straddle the north coast of the Burry Inlet between Llanelli and Burry Port, and between Kidwelly and Ferryside, also act as coastal defences and prevent the inland migration of coastal habitats under a rise in relative sea level.

The area around Carmarthen is important for agriculture particularly sheep farming. The saltmarshes found exclusively within the estuaries are extensively grazed, sometimes at high intensity.

There are small to medium-scale harbour facilities at Llanelli, Burry Port, Tenby and Saundersfoot, with the total number of moorings (including at Llansteffan, Ferryside and Loughor) approaching 1,000. Some approaches and navigations channels into these facilities are being maintenance-dredged intermittently. Some of the arisings are being used locally at Tenby and Burry Port for beach recharge.

Recreational boating of a variety of types is popular throughout the EMS, including sailing, low and high-powered craft (including jet-skis), kayaking and kite surfing. Recreational sea angling is also extremely popular and takes place from the shore and from boats, with a number of charter boats operating within the EMS. Levels of bait collection, including for a variety of marine worms and soft shelled 'peeler' crab, are consequently high.

There have been historical changes in sewage treatment and disposal. A historical long-term increase was followed by a relatively recent decrease in solids and nutrients outputs, and changes in disposal points. Within the Burry Inlet, Burry Port, Pwll, Northumberland (Old Llanelli) and Bynea were separate primary treated STWs and these were converted to SPSs to convey sewage to the new Llanelli STW completed in 1995. Further work on the intermittent discharges commenced in the Llanelli and Gowerton sewerage systems including the Llannant sewerage system. These were completed under UWWTD, Bathing Water and Shellfish Water drivers, and would have reduced the number of spills to the estuary from each of these assets.

The area is important for commercial shellfish and finfish fisheries. The Burry Inlet cockle fishery is regulated by NRW whilst commercial cockle gathering operations in the Three Rivers Estuary and western Carmarthen Bay are regulated by Welsh Government. There is a seed mussel fishery regulated by Welsh Government at Whiteford Point. Capture fisheries take place for a variety of species including crabs, lobsters, whelks, bass and various flatfish, including rays.

3.6 Modifications as a result of human activity

Many anthropogenic activities have the potential to affect the structural and functional characteristics of the SAC and these effects are considered to be significant where a subsequent detrimental impact on the species and communities associated with the five habitat features of the SAC would result. An assessment of the conservation status of each of the features, at a UK level, was first reported in 2001, again in 2007 and most recently in 2013²⁷.

²⁷ Joint Nature Conservation Committee. 2013. General Implementation Report - 3rd UK Habitats Directive Reporting 2013. Available from: <http://jncc.defra.gov.uk/page-6387>

Various anthropogenic activities currently taking place within the EMS have an influence on the habitat and species features and Section 6 provides additional information on the ways in which 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 EMS and its habitat and species features are inherently important attributes of the marine ecosystem, it is the effect that these characteristics have on the wildlife of the EMS that is of conservation importance.

Many activities have the potential to create pressure or threat by causing direct damage to habitats, or disturbance to wildlife, for example from noise or high speed activity, or by competing with wildlife for space.

Activities currently believed to be pressures (not in any particular order):

- Levels of exploitation of ecologically important shellfish species (e.g. cockles, mussels and mussel seed, whelks, razor clams)
- Creation & maintenance of hard engineered coastal defence works
- Water pollution: diffuse and point source
- Land claim
- Grazing
- Bait collection, particularly digging
- High speed power craft (e.g. Jet skis)
- Disposal of wastes & debris
- Military activity

Activities currently believed to be threats include:

- Sea level rise
- Coastal 'squeeze'
- Aquaculture
- INNS
- Aggregate extraction
- Mass cockle mortality events
- Marine litter
- Modifications to sediment transport
- Short term planning policies and unsustainable development
- Poor public awareness, understanding or interest

More information is needed on the distribution, timing and intensity of all activities, but in particular on:

- Commercial fishing
- Angling
- Bait collection
- Recreational high speed boating and water-sports
- Off-road motor sports in intertidal areas
- Unregulated wildfowling
- Unregulated rubbish disposal (fly-tipping)
- Unregulated foreshore development
- Unregulated coastal protection & land claim

- Vessel maintenance (including cleaning and painting antifouling)
- Marine wildlife watching / 'eco-tourism'
- Scientific research
- Unregulated gathering of marine resources (e.g. razor clams, seaweed, driftwood)

4. Feature Descriptions

4.1 Estuaries

Estuaries are defined in the EU Habitats Interpretation Manual²⁸ as:

“Downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. River estuaries are coastal inlets where, unlike 'large shallow inlets and bays' there is generally a substantial freshwater influence. The mixing of freshwater and seawater and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal mud and sand-flats. Where the tidal currents are faster than flood tides, most sediments deposit to form a delta at the mouth of the estuary.”

“An estuary forms an ecological unit with the surrounding terrestrial coastal habitat types”

There are four major types of estuary recognised within the EC definition:

1. Coastal plain estuaries: formed where pre-existing valleys were flooded at the end of the last glaciation and usually less than 30m deep, with a large width-to-depth ratio. The main sub-type of estuary, by area, in the UK.
2. Bar-built estuaries: characteristically have a sediment bar across their mouth and are partially drowned river valleys that have subsequently been inundated. Bar-built estuaries tend to be small but are widespread around the UK coast.
3. Complex estuaries: formed by a variety of physical influences, such as glaciation, river erosion, sea-level change and geological constraints from hard rock outcrops. There are few examples of this sub-type of estuary in the UK.
4. Ria estuaries: drowned river valleys, characteristically found in south-west Britain. The estuarine part of these systems is usually restricted to the upper reaches. The outer parts of these systems are little diluted by freshwater and typically conform to Annex I type 'large shallow inlets and bays'.

Estuaries are widespread throughout the Atlantic coasts of Europe, but approximately one quarter of the area of estuaries in north-western Europe occurs in the UK. The Carmarthen Bay and Estuaries SAC includes coastal plain and bar built estuaries.

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

- Estuarine rocky habitats
- Intertidal mudflats
- Mussel beds

²⁸ Interpretation Manual of European Union Habitats. EUR27, July 2007. European Commission. DG Environment.

- Seagrass beds

4.1.1 Range

Carmarthen Bay & Estuaries SAC is a large estuarine site, encompassing the estuaries of the Rivers Tâf, Tywi, Gwendraeth and Loughor (Burry Inlet). Together they form a single functional unit around the Burry Inlet, with important interchanges of sediment and biota and represent approximately 3.4 % of the UK SAC “**estuary**” resource. The total extent of the intertidal mudflats and sandflats, intertidal hard substrate, subtidal sediment and hard substrate communities, *Salicornia* communities, Atlantic salt meadows and transitional saltmarsh communities is around 9,500 ha.

The saltmarsh to sand dune transition communities are mainly distributed in the Burry Inlet at Pembrey Burrows, but are also recorded from west Taf and Tywi estuaries, west Penrhyn Gwyn and Penclacwydd (Burry Inlet). The noteworthy transitions occur between grazing marsh and dune slacks within semi-fixed dune systems. Such vegetation is present at a small scale at Morfa Uchaf and Llansteffan on the Tywi, near Ginst Point at the mouth of the Taf and, most impressively, at the western end of the Gwendraeth saltmarsh. At the latter location, conservation value is enhanced by the associated transitions from mid-marsh to tall mesotrophic inundation grassland.

4.1.2 Structure and function

The Carmarthen Bay estuaries were created primarily by the underlying geological features and then infilled with the prevailing mobile substrata and modified by the hydrographic regime. The area is underlain and partially bound by Carboniferous and Devonian limestones and sandstones. Overall the variety and distribution of intertidal sediments extends from well-sorted fine to medium sands at the mouths of the estuaries to muddy sand in their middle reaches and mud in the upper reaches and the back of the shores. The subtidal channels are dominated by mobile sands. This site has a variety of undisturbed transitions to coastal habitats.

- The **Tywi** is a typical ria or coastal plain estuary that was created by marine inundation of the river valley.
- The **Taf** is a combination of typical coastal plain and bar-built estuaries. Below Laugharne it is bar-built, due to the easterly growth of Pendine and Laugharne sands; above Laugharne it can be considered a ria or coastal plain estuary.
- The **Gwendraeth** is a typical bar-built estuary that was created by the north westerly extension of the dune/beach coastal barrier, of which Cefn Sidan sands forms the seaward part. The southern part of the Gwendraeth estuary drains extensive areas of saltmarsh.
- The **Loughor** (Burry Inlet) is a typical bar-built estuary.

Barrier beaches at the mouths of the estuaries and adjacent coast are a fundamental feature of the estuaries because they absorb wave energy and protect the lower estuary, which allows fine grained suspended sediments to be deposited on saltmarshes within the relatively sheltered estuaries. Sediment moves along the shores by longshore drift to supply recurved spits at Ginst Point, Tywyn Point, Morfa Heli and Whiteford Point. An exposure of subtidal peat to the south of Salmon Scar may have an important influence on the morphology of the Three Rivers estuaries however, further work is required to evaluate its importance.

The feature is characterised by largely mixed, variable salinity water typical of macrotidal estuaries. The mean tidal range for the estuaries is 5.5 m and the typical salinity range is from 33 - 2‰. The tidal curve of these west facing macrotidal estuaries is asymmetric with an ebb duration of almost 10 hours on a spring tide and flood duration of 2-3 hours, the tidal range is at least 6.6m on spring tides. The annual average freshwater flow is 5.6m³/s from the Loughor, 7.4m³/s on the Taf, 43.4m³/s on the Tywi and 4.8m³/s on the Gwendraeth. Total flow into the Burry Inlet is 10.2 m³/s.

Dissolved Inorganic Nitrogen (DIN) data gathered for Water Framework Directive (WFD) purposes demonstrate the waters of the Carmarthen Bay estuaries (Three Rivers, Loughor Inner and Loughor Outer WFD water bodies) are hyper-nutriented as the water bodies are currently failing to achieve good ecological status for this element. There is also evidence of an ecological response to the elevated nutrient levels as phytoplankton is currently failing to achieve Good status but confidence in this classification is currently low and we will therefore continue to monitor to increase confidence and gain a better understanding of the response of this element to the nutrient pressures. Nutrient stripping was implemented at Gowerton, Llanelli, Parc-y-Splotts and Pontyberem Welsh Water Treatment Works in March 2015 as a measure aiming to reduce nutrient levels within the estuaries. NRW will continue to review the water quality monitoring data to see if the nutrient stripping is having a positive effect on nutrient levels; a preliminary review of the data was carried out earlier in 2016 which showed a clear reduction in nutrient phosphorus within the estuary following nutrient stripping, demonstrating these measures are indeed having a positive effect.

Sediment nutrient levels are unknown, but assumed to reflect concentrations in overlying water. The levels of contaminants in the water column and sediments are unknown. However, there have been inputs of heavy metals from industry and redundant coalmines into the estuaries. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales²⁹.

The different physiographies and hydrodynamic regimes of the estuaries provide for a wide range of combinations of wave exposure and tidal streams. Generally, above mid-shore the extensive intertidal flats are fairly stable and flat. Below mid-shore the extensive sandflats, are very mobile with frequent large sand waves and ripples. Sandbanks in the entrances of the estuaries are particularly mobile. The estuaries continue to be filled in, driven by a rise in relative sea level, superimposed by changes in wind-wave climate.

The Burry Inlet and the Three Rivers system contain an important nursery area for bass *Dicentrarchus labrax* with the juvenile bass presumed to use all of the subtidal habitats during the summer months. The estuaries also provide a migratory route for salmonids, lampreys and shads.

4.1.3 Typical species

The estuaries contain both subtidal and intertidal habitats, although the latter are a lot more extensive in this SAC. In addition to the truly marine habitats and associated wildlife, a wealth of coastal and terrestrial habitats are all part of the estuary complex with, in undisturbed or unmodified situations, transitions from marine communities to brackish,

²⁹ <http://waterwatchwales.naturalresourceswales.gov.uk/en/> relevant waterbodies for this site include: 3 rivers (Tywi, Gywyn & Gwendraeth), Loughnor, Loughnor Outer & Carmarthen Bay.

maritime, freshwater and terrestrial habitats. A number of these habitats, such as mudflats and sandflats and saltmarshes are recognised as Annex I habitats in their own right.

The mosaic of habitats within the estuaries supports a large variety of different wildlife communities. In the intertidal and subtidal sediments, there are communities of worms, crustaceans and molluscs depending on the type of sediment, the salinity gradient and degree of exposure of the sediment to wave action and tidal streams. Where there is rocky habitat, green and brown seaweeds generally develop with some communities being characteristic of the variable salinity conditions. Transitions from saltmarsh to brackish, maritime and freshwater communities support their own particular assemblages of plants and animals. The estuaries also support an assemblage of mobile species. Estuaries can provide important nursery areas for fish species and also provide a means by which migratory fish species make the transition between the marine and freshwater environments.

The range of benthic communities in the Three Rivers is strongly influenced by the geology, topography and tidal currents, whilst in the Burry Inlet the major factors are salinity, sediment stability and substratum composition. The mobile, sandy sediments are characterised by the presence of low numbers of amphipods, isopods and robust, mobile polychaetes.

The fauna of intertidal sediments includes communities with polychaete and oligochaete worms and areas with extensive cockle beds and other bivalve molluscs. Forty-three intertidal biotopes were recorded in a mapping survey completed in 2000.

These include communities with polychaete and oligochaete worms and extensive cockle beds on intertidal sediments as well as barnacle and mussel dominated communities in areas of sand scoured intertidal rock. A species assemblage characterised by hydroids, ephemeral seaweeds and the winkle *Littorina littorea* in shallow eulittoral mixed substrata pools is more unusual because of its limited geographic distribution and because it is typically only found associated with mussel beds. Within the SAC it occurs on Salmon Point Scar, east of Burry Port, Whiteford Point, west of Penclacwydd and Loughor Bridge.

Relatively undisturbed transitions between saltmarsh and brackish systems are present. These include swamp, mire, mesotrophic grassland and open vegetation communities, and mostly occur in the mid and upper reaches of the Taf and Tywi Estuaries, around the Gwendraeth Estuary, west Pembrey Burrows, west Landimore Marsh, west and upstream of the bridge in the Loughor estuary.

4.1.4 Natural processes

The structure of estuaries is largely determined by geomorphological and hydrographic factors, with the original shaping forces having their beginnings in the geological origins of the adjacent land areas and the influence of major geological events such as ice ages and periods of higher and lower sea levels. The shape of the estuaries, their macro- and micro-topography, and bathymetry, are important components of the character of the habitats and influences the distribution and abundance of marine life, *i.e.* the features' typical species. It is both determined by, and influences, natural environmental processes and consequently, can be impacted either directly or indirectly (through changes to natural processes) by man.

Estuaries are complex dynamic systems that have a natural tendency to accumulate sediment, thereby changing their form from their original Holocene morphology to a state where tidal energy is dissipated by sub- and intertidal sediment banks. The width and depth of the estuary will therefore change over time towards a state of dynamic equilibrium or “most probable state”.

The velocities of currents passing through the mouth are determined partly by the tidal range and partly by the cross sectional area of the mouth itself. If these velocities are higher than the sediment erosion threshold, erosion will widen the channel and lower velocities will ensue. If velocities are lower than the sediment depositional threshold, deposition will narrow the mouth and higher velocities will ensue. In this way, an equilibrium cross section will evolve which balances tidal prism, velocities and erosion/depositional thresholds. Sea level rise means that estuaries will show a natural tendency to translate inland (roll-over) and may erode at the mouth. Where changes in extent are attributable to the estuary adjusting to equilibrium, then the feature should be determined favourable. Where this process is constrained by hard sea defence, then this would be considered as coastal squeeze³⁰.

A complex pattern and combination of physical, chemical and biological conditions and processes operates within estuaries, with many parameters varying temporally and spatially. These parameters establish the baseline conditions in the estuary and continually shape the estuaries and the habitats and wildlife they support. The key parameters are: the flood hydrograph; the nature of the catchment and its influence on freshwater flow and nutrient and sediment input; the nature of the estuary sediment; and the relatively high sediment levels in the estuaries resulting in low water retention within the estuary system and exposure of significant proportions of sediment at low tide. The biological communities of the estuaries have developed in response to these prevailing conditions and the daily patterns of water flow, exposure, sediment movement and water chemistry.

4.1.5 Modification as a result of human activity

Compared to many estuaries in the UK, the extent of those in the Carmarthen Bay & Estuaries SAC are relatively uncompromised by extensive land claim although all of the estuaries have undergone significant modifications and are readjusting to their modified physical form. In more recent times saltmarsh was lost during the 20th century, largely to land claim, but half of this area has been compensated for by additional saltmarsh due to sediment infilling of the estuaries.

It is expected that tidal levels will gradually rise in response to global climate change through an increase in the rate of sea-level rise. Floodplains along the upper estuary will experience increased tidal inundation and change to saltmarsh. It is important that the upper estuarine floodplains are protected from development in order to allow changes to occur in the upper estuaries.

The waters of the Carmarthen Bay estuaries (Three Rivers, Loughor Inner and Loughor Outer WFD water bodies) are hyper-nutriented. There is also evidence of an ecological response to the elevated nutrient levels as phytoplankton is currently failing to achieve Good status but confidence in this classification is currently low and we will therefore continue to monitor to increase confidence and gain a better understanding of the

³⁰ See the Lavernock Point to St. Ann's Head Shoreline Management Plan (<http://www.southwalescoast.org/content.asp?id=58>)

response of this element to the nutrient pressures. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales³¹

In addition, there have been inputs of heavy metals from industry and redundant coalmines in the estuaries. Inputs of fine sediments from rivers into all of the estuaries are small, compared to other sources of material (inward migration from the sea). This is reflected in the character of the estuaries and the habitats within them.

4.2 Mudflats and Sandflats not covered by seawater at low tide

Mudflats and sandflats not covered by seawater at low tide are defined in the EU Interpretation Manual as:

“Sands and muds of the coasts of the oceans, their connected seas and associated lagoons, not covered by sea water at low tide, devoid of vascular plants, usually coated by blue algae and diatoms. They are of particular importance as feeding grounds for wildfowl and waders..... Eelgrass communities are included in this habitat.”

In this document they are referred to as the ‘intertidal mudflats and sandflats’ feature.

There are three major categories of intertidal mudflats and sandflats although in practice they tend to be present as a continuous gradation between these categories depending on the prevailing conditions:

1. Clean sands - in areas exposed to wave action and strong tidal currents. May be found on open coast areas and estuary mouths.
2. Muddy sands – occur on more sheltered shores along the open coast and the lower reaches of estuaries.
3. Mudflats – only form in the most sheltered areas of the coast, usually where large quantities of silt derived from rivers are deposited.

Intertidal mudflats and sandflats form a major component of two other Annex I habitats (estuaries and large shallow inlets and bays) but also occur independently, sometimes covering extensive areas along the open coast.

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

- Intertidal mudflats
- Seagrass beds

4.2.1 Range

The SAC includes large areas of intertidal mudflats and sandflats the most extensive being the wide expanses of Llanrhidian Sands, Cefn Padrig and Dafon Sands, in the lower and middle estuary of the Burry Inlet. The mudflats and sandflats cover around 7,000 ha, thus comprising 2.4 % of the UK resource and approximately 10 % of the area of the SAC.

³¹ <http://waterwatchwales.naturalresourceswales.gov.uk/en/> relevant waterbodies for this site include: 3 rivers (Tywi, Gwyn & Gwendraeth), Loughnor, Loughnor Outer & Carmarthen Bay.

4.2.2 Structure and function

The mudflats and sandflats occur as narrow bands as well as very expansive areas. Some are almost horizontal while others, particularly those adjacent to tidal channels and creeks, are steeply inclined. This diverse range of physiographies and morphologies with varying degrees of physical exposure to wind, waves and tides, gives rise to an equally wide range of hydro- and aerodynamic settings. The sedimentary environments also vary greatly with sediment types ranging from mobile fine and medium sands, muddy sands, sandy and silty muds, and pure muds, to limited areas of exposed immobilised sandy and / or muddy gravel pavements.

There is a gradation within the distribution of sediments, from mud in the upper, more sheltered regions of the estuaries, to sand at the more wave-exposed mouths of the estuaries. The sandy shores of South beach (Tenby), Waterwynch Bay, Monkstone beach and Cefn Sidan sands, between the Three River system and the Burry Inlet, consist mainly of mobile fine and medium sands.

The mudflats and sandflats of the Three Rivers system and that of the Burry Inlet and River Loughor are mostly sandy gravel or muddy sand. Sheltered sandy gravel shores are found from the edge of Pendine Sands, stretching around into the mouth of the Three Rivers system, where a variety of different sediment types are found. The mouth of the Three Rivers system is dominated by moderately mobile fine sands that are continually shifted by waves and tidal action. The intertidal flats of the estuaries are predominantly sandy, although the upper reaches of the rivers are muddy, and each of the tributaries has areas of saltmarsh.

Salinity varies from less saline conditions within the estuaries to fully marine along the more open stretches of coastline in between. The waters of the Carmarthen Bay estuaries (Three Rivers, Loughor Inner and Loughor Outer WFD water bodies) are hyper-nitrified. There is also evidence of an ecological response to the elevated nutrient levels as phytoplankton is currently failing to achieve Good status but confidence in this classification is currently low and we will therefore continue to monitor to increase confidence and gain a better understanding of the response of this element to the nutrient pressures. The levels of contaminants in the water column and sediments are unknown. However, there have been inputs of heavy metals from industry and redundant coalmines into the estuaries. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales³²

4.2.3 Typical species

Large areas of the intertidal mudflats and sandflats are dominated by bivalves. In areas of fine sand cockles *Cerastoderma edule* are abundant, along with other bivalves, amphipods and worms. In muddier sediments the sand-gaper *Mya arenaria*, peppery furrow-shell *Scrobicularia plana* and mud-snail *Peringia ulvae* are also found in large numbers. The lower Loughor Estuary is one of the few places in the UK where the worm *Ophelia bicornis* has been found. There are also beds of the nationally scarce dwarf eelgrass *Zostera noltei*.

Areas of mobile fine and medium sands such as South Beach and Cefn Sidan sands support large populations of burrowing amphipods and polychaetes. The polychaetes

³² <http://waterwatchwales.naturalresourceswales.gov.uk/en/> relevant waterbodies for this site include: 3 rivers (Tywi, Gywyn & Gwendraeth), Loughnor, Loughnor Outer & Carmarthen Bay.

Nephtys cirrosa and *Arenicola marina*, the amphipod *Bathyporeia pelagica* and the isopod *Eurydice pulchra* are the most abundant species and, in more stable sediment areas, polychaetes and the cockle *Cerastoderma edule* are found in abundance.

The communities at the mouth of the Three Rivers system are characterised by the Baltic tellin *Macoma balthica*, thin tellin *Angulus tenuis* and polychaetes *Nephtys* spp. Stable sandflats are present in the lower estuary, generally on the upper middle shores. Here tidal streams and salinity fluctuations are reduced, resulting in greater species richness than in the lower shore areas. The communities support typical bivalve / polychaete and amphipod assemblages.

The sediments of Llanrhidian Sands, Cefn Padrig and Dafon Sands are moderately stable, fine and very fine sands. The cockle *Cerastoderma edule* is one of its most characteristic species. In the more stable areas with a higher mud content, the sand gaper *Mya arenaria*, peppery furrow shell *Scrobicularia plana*, the mud snail *Hydrobia ulvae* and amphipods *Corophium* spp. are found in increasing numbers, as are the amphipods *Bathyporeia pilosa* and *Corophium* spp. Nearer the channel muddy areas are dominated by polychaetes and the Baltic tellin *Macoma baltica*.

There are very large populations of cockles in the Burry Inlet and in the Three Rivers, covering just over 940 ha of the intertidal sandy mud and sand habitats. These in turn form the principle food source for oystercatcher in the Burry Inlet SPA and Ramsar site.

Along the high wave energy exposed coastlines of Saundersfoot to Telpyn, Marros to Pendine and along the Pembrey Coast, extensive and complete sequences of exposed sand zonations are present. Species assemblages characterised by the common heart urchin *Echinocardium cordatum* and razor shells *Ensis* sp. occur along Carmarthen Bay on the shallow lower shore where conditions are fully marine. Other associated species include the otter shell *Lutraria lutraria* and the bivalve mollusc *Pharus legumen*. Sites include North Tenby beach, Monkstone Beach, between Monkstone Point and Saundersfoot Harbour, at Marros and Pendine Sands and between Towyn Point and Pembrey Burrows.

The intertidal soft sediment coastline of Carmarthen Bay has extensive and substantial strandlines. A wealth of invertebrate fauna has been identified at locations including Pendine, Pembrey and Whiteford, most notably high abundance of the nationally scarce strandline beetle (*Nebria complanata*). Sandhoppers are the dominant order of marine invertebrates with three of the five genera found regularly feeding on the algae deposits.

In the Burry Inlet, there are areas of the scarce and specialised biotope characterised by the dwarf seagrass *Zostera noltii* along the Great Pill, between Berges Island and Landimore Marsh, and on Llanrhidian Sands and at Penrhyn Gwyn. As well as stabilising the sediment the seagrass is an important source of food for wildfowl, particularly Brent goose and wigeon that feed on the intertidal beds.

The unusual angiosperm wigeongrass *Ruppia maritima* is recorded from one location in the middle reaches of the Tywi Estuary at Morfa Uchaf. This species grows in soft sediments in sheltered shallow coastal waters, from full salinity to nearly freshwater, but mainly in brackish waters, including those of estuaries. *R. maritima* attracts in particular waterfowl and fish to feed and rear their young. The currently considered nationally rare

polychaete worm *Ophelia bicornis* has been recorded from the sand bars and flats of mobile sand along the Burry Inlet / Loughor Estuary. *Ophelia* feeds on particles of organic material in the sediment and produces swimming planktonic larvae that are very particular about the quality of the sediment that they will colonise.

4.2.4 Natural processes

Intertidal mudflats and sandflats are dynamic features. Their distribution, extent, shape, topography, aspect and orientation is the product of complex interaction between hydrodynamic and sediment transport processes, sediment supply and coastal morphology. Hydrographic functions that structure intertidal mudflats and sandflats encompass highly dynamic hydrodynamic and other properties that vary with short and long-term natural cycles, climate influences and stochastic events.

The structure of intertidal mudflats and sandflats varies depending on the physical conditions and forces acting on them (in particular the degree of exposure to wave action and tidal currents) as well as the nature of the sediments occurring in any one location. The sediments vary from mobile coarse sand in more wave exposed areas to stable, fine sediment expanses of mudflat in estuaries and other marine inlets.

Intertidal mudflats and sandflats support a variety of different wildlife communities. These are predominantly infaunal communities of a variety of different animal species such as worms, molluscs and crustaceans living within the sediment habitat. The type of sediment, its stability and the salinity of the water have a large influence on the wildlife species present.

4.2.5 Modifications as a result of human activity

Summer cockle mortality has occurred yearly in the Burry Inlet since August 2002 and in the Three Rivers estuary since August 2005. The mortalities are of a continuing nature and occur mainly during the summer periods (June – July) each year. Cockle numbers in the Burry Inlet altered dramatically in 2004 with very few older cockles left on the beds. Now, the Burry Inlet primarily consists of a single age class population spawning from April – June and often multiple times in the same year. The cause of the summer mortality events are likely to be multifactorial. There is very little evidence of disease but some evidence of parasite numbers increasing immediately prior to mortality events.

Episodic events of mass mortality involving bivalves have been recorded with increasing frequency and intensity worldwide since the 1970s. Mass mortalities have been attributed to a number of potential factors including environmental conditions, climate change, anthropogenic inputs, infectious agents and physiology or genetics of the organism. Environmental aspects linked to mortality include algal blooms, declines in water quality, eutrophication, temperature, salinity, and extreme events such as storms.

The 2012 investigation report by Hull university found no evidence of water or sediment quality contributing to the mortalities and that no other biota or bivalves were affected and the mortalities was confined to the cockle population only. NRW are currently reviewing the recommendations of the Burry Inlet Mortality Investigation Report 2009-2011³³, and a number of the recommendations have been implemented or can be ruled out. Initial findings highlight the need to focus on understanding the origin of high parasite numbers in

³³ Burry Inlet Cockle Mortalities Investigation 2009-2011, Technical Report to Environment Agency Wales by Institute of Estuarine and Coastal Studies University of Hull 17 January 2012.

the Burry Inlet compared to other cockle fisheries, and to ensure adequate biosecurity measures are in place by the processing industry as a result of movement of cockles to the area for processing.

4.3 Atlantic Salt Meadows

Atlantic salt-meadow (*Glauco-Puccinellietalia maritimae*) is defined in the EU Habitats Interpretation Manual as “Salt-meadows of Baltic, North Sea, English Channel and Atlantic shores”

Eleven different plant communities are represented by this SAC habitat in the UK which occurs on North Sea, English Channel and Atlantic shores.

Atlantic salt meadows develop when plants able to tolerate salty soil conditions colonise soft intertidal sediments of mud and sand in areas protected from strong wave action. The vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation still occurs but with decreasing frequency and duration than areas nearer to the low water mark in estuaries and coastal locations.

The vegetation that is present varies with climate and the frequency and duration of tidal inundation. Grazing by domestic livestock is particularly significant in determining the structure and species composition of the habitat type and in determining its relative value for plants, invertebrates and wintering or breeding waterfowl.

4.3.1 Range

The Carmarthen Bay and Estuaries SAC includes the largest expanse of saltmarsh in Wales covering 2478 ha. The extensive saltmarshes of the Carmarthen Bay estuaries have a complete sequence of saltmarsh vegetation, from pioneer vegetation through to upper saltmarsh transitions. The area is also important for transitions from saltmarsh to sand dune and to freshwater and terrestrial vegetation. These are important features of the local saltmarshes and of great biodiversity value.

The estuarine systems have exceptionally well developed saltmarsh to sand dune transitions, where blown sand has modified the upper saltmarsh vegetation. The transition communities are mainly distributed in the Burry Inlet at Pembrey Burrows, but are also recorded from west Taf and Tywi estuaries, west Penrhyn Gwyn and Penclacwydd (Burry Inlet). The noteworthy transitions occur between grazing marsh and dune slacks within semi-fixed dune systems. Such vegetation is present at a small scale at Morfa Uchaf and Llansteffan on the Tywi, near Ginst Point at the mouth of the Taf and, most impressively, at the western end of the Gwendraeth saltmarsh. At the latter location, conservation value is enhanced by the associated transitions from mid-marsh to tall mesotrophic inundation grassland.

The feature has a variety of relatively undisturbed transitions between saltmarsh and brackish (swamp) systems. These include swamp, mire, mesotrophic grassland and open vegetation communities, totalling 98.0 ha. The transition communities are largely distributed in the mid and upper reaches of the Taf and Tywi estuaries, around the Gwendraeth Estuary, west Pembrey Burrows, west Landimore Marsh, west and upstream of the bridge in the Loughor estuary. Transitions to freshwater inundation communities are especially prominent at the western extremity of the Gwendraeth Estuary.

The grazed saltmarshes include upper margins with sea rush *Juncus maritimus* and marsh-mallow *Althaea officinalis*, which are a particularly distinctive ecological feature of this site. The area is also important for transitions from saltmarsh to sand dune and other habitats.

The Burry Inlet has around 1640 ha of Atlantic saltmeadows with the largest extent at Llanrhidian-Landimore (1094.8 ha) then Penclawdd (411.8 ha) the Loughor Estuary (273.1 ha) Penrhyn Gwyn (129.97 ha) and the Pembrey coast (106.86 ha). In the Three Rivers complex there is a total of 838 ha (Gwendraeth Estuary: 467 ha, Taf Estuary: 223 ha, and Tywi Estuary: 148 ha).

Transitional low-marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Sueda maritima* is present over significant areas of the Llanrhidian-Landimore marshes, and also occurs in moderately extensive areas at Penclawdd. Elsewhere stands were small and with the exception of the lower Loughor estuary, poorly developed. Rayed *Aster tripolium* communities are scarce in the Burry Inlet, being present only at Loughor and Pembrey, and even here they are not well developed. In comparison, grazed and ungrazed stands of *P. maritima* communities were noted at all sites, although ungrazed stands are only extensive at the Loughor Estuary where it accounts for around 20% of all saltmarsh vegetation.

Halimione portulacoides saltmarsh communities are relatively poorly represented in the Burry Inlet. Sizeable ungrazed stands are restricted to Penrhyn Gwyn, where they formed good transitions with other units and grazed stands were well developed at Loughor. *Festuca rubra* communities are the second most widespread unit of the Inlet, with extensive (>100 ha) cohesive stands mapped at the Llanrhidian-Landimore site and with sizeable areas (ca. 50 ha) also mapped at Penclawdd and Loughor. *Artemisia maritima* communities was recorded at the Pembrey site, with particularly well developed stands along the more inland creek edges and extending towards the lower marsh, at Penclawdd. The area of *Juncus maritimus* saltmarsh community along the Burry Inlet is 276.97 ha.

Within the Three Rivers complex transitional low-marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Sueda maritima* is present over a significant area (ca. 50 ha) on the Gwendraeth, but has only fragmentary representation on the Taf, and on the Tywi is restricted to a small but good quality stand at Morfa Uchaf. Rayed *Aster tripolium* communities are widespread with good stands on all three estuaries. Both grazed and ungrazed types of *P. maritima* communities are present, although ungrazed expressions are uncommon on the Tywi and the Taf. In contrast *Halimione portulacoides* communities are present in large quantities and of good quality on both the lower Taf and the Gwendraeth.

Juncus maritimus-*Triglochin maritimus* saltmarsh, is poorly represented, but the associated *J. maritimus* is a conspicuous feature of the estuary system with a total cover well in excess of 50 ha and all three sub-communities are well represented, Morfa Uchaf supports a small patch of *Eleocharis uniglumis* with halophytic associates which may be a relic of a former stand now subsumed within the surrounding inundation vegetation.

4.3.2 Structure and function

Many of the saltmarshes are dissected by small creeks and channels, which provide microhabitats within more uniform areas of marsh. Saltpans and small pools add diversity to the site and are an intrinsic part of many marshes. The marshes on the southern side of the Burry Inlet between Whiteford Point and Loughor are of national significance in respect of a variety of geomorphological features, including creeks, saltpans, erosion cliffs and a variety of sediment types.

The dendritic creek systems of the Burry Inlet and the Gwendraeth are the very well developed and are the most extensive, followed by the Pembrey saltings. Short, but still profusely dendritic saltmarsh creeks, are also characteristic features of the smaller saltmarsh expanses along the Taf and the Tywi. Near Clomendy Farm on the middle Tywi Estuary, the predominantly linear pattern of tidal creeks is the result of the excavation of drainage ditches.

Landimore, Llanrhidian and Berthlwyd marshes have developed in sequence from east to west. The mature marshes at Berthlwyd display well developed terraces and an eroding marsh cliff while at Llanrhidian both pans and creeks are present and the marsh is heavily dissected. At Landimore an intricate and deep creek network is present. This sequence of marshes forms a key area for the understanding of saltmarsh dynamics, sediment transport and sea level changes.

4.3.3 Typical species

This extensive site has a complete sequence of saltmarsh vegetation, from pioneer vegetation through to upper saltmarsh transitions. The grazed saltmarshes include upper margins with sea rush *Juncus maritimus* and marsh-mallow *Althaea officinalis* which are a particularly distinctive ecological features of the site. The area is also important for transitions from saltmarsh to sand dune and other habitats.

Notable saltmarsh species and communities include stands containing good populations of *Althaea officinalis* that were extensive at Llanrhidian-Landimore, and also present on Loughor and Penrhyn Gwyn and stands of *Seriphidium maritimum* which were well represented at Pen-clawdd, and also occurred on the other sites, although in lesser quantity. Good populations of *Limonium vulgare* have been recorded at all sites, and were particularly well represented at Llanrhidian-Landimore. Two nationally scarce plant species also occur on the Taf Estuary, namely the rock sea-lavender *Limonium procerum* and bulbous foxtail *Alopecurus bulbosus*. Three known populations of *Bryum marratii*, a bryophyte listed as Vulnerable in the UK Red Data List³⁴ and Endangered in the Welsh Red Data List³⁵, are located on upper saltmarsh transitions where there is freshwater flushing at Landimore marsh and on the Tywi and Gwendraeth Estuaries.

The majority of saltmarsh insects are sap-sucking aphids, while deposit feeders such as *Limecola baltica*, *Corophium volutator* and *Arenicola marina* and predators like *Hediste diversicolor* and *Nephtys hombergii* are likely to be present. *Peringia ulvae* grazes the microflora from sediment grains and epiphytes. Areas with high structural and plant diversity, particularly where freshwater seepages provide a transition from fresh to brackish conditions, are particularly important for invertebrates.

³⁴ Hodgetts (2011)

³⁵ Bosanquet & Dines (2001)

Saltmarshes are an important resource for wading birds and wildfowl. They act as high tide refuges for birds feeding on adjacent mudflats, as breeding sites for waders, gulls and terns and as a source of food for passerine birds particularly in autumn and winter. In winter, grazed saltmarshes are used as feeding grounds by large flocks of wild ducks and geese.

4.3.4 Natural processes

The location, character, and dynamic behaviour of saltmeadows are governed by four physical factors: sediment supply, tidal regime, wind-wave climate and the movement of relative sea level. There are four elements necessary for the development and growth of a salt marsh: (1) a relatively stable area of sediment that is covered by the tide for a shorter period than the time it is exposed; (2) a supply of suitable sediment available within the period of tidal cover; (3) water velocities that are sufficiently low for some of the sediment to settle out; and (4) a supply of seeds or other propagules for the establishment of vegetation cover.

The topography and microtopography of areas of Atlantic salt meadow are the product of complex interaction between hydrodynamic and sediment transport processes, sediment supply and coastal morphology. These can be highly dynamic and vary with short and long-term natural cycles, climate influences and stochastic events, including: tidal range and excursion, salinity, water temperature and suspended particulate concentrations.

The marsh-edge morphology provides information on the short to medium term trends of marsh morphodynamics. Accreting and stable seaward marsh edges have an accretional ramp upon which pioneer and low-marsh vegetation can become established. Erosional margins are characterised either by the presence of mud-mound topography or by marsh-edge cliffs fronted by toppled cliff blocks with live or dying vegetation, rotational slide or overhanging (cantilever) blocks. Terraced marsh margins indicate episodic erosion and accretion on timescales over decades to centuries.

Creeks and pans of varying size and density are frequent features of the saltmeadows. Creeks absorb tidal energy and assist with the delivery of sediment into saltmarshes. The efficiency of this process depends on creek pattern. Creek density is influenced by vegetation cover, suspended sediment load and tidal influence. Creeks allow pioneer vegetation to become established along their banks higher into the saltmarsh system. Natural salt pans can occur at any level in a saltmarsh. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network, ultimately leading to the creation of mud basins. Contaminants may be tied up in saltmarsh sediments for relatively long periods of time and shifts in the dynamics of processes can lead to the remobilisation of sediments. Cyclical patterns of erosion and accretion may, therefore, lead to the release and re-deposition of pollutants within the system.

Nutrient levels are a strong influence on the growth of estuarine saltmarsh plants. Nutrient cycling within saltmarshes can also have a significant effect on coastal and estuarine water quality. In this respect, healthy, functional saltmarsh habitat may have an important role to play in the control of nutrients, which are important in determining water quality.

Given favourable conditions, depending on sediment supply and hydrodynamic regime, mudflats evolve into saltmarshes by way of substrate stabilisation by algae, diatoms and early pioneer plants, giving rise to enhanced sediment accretion rates.

4.3.5 Modifications as a result of human activity

Areas of unimproved saltmarsh are subject to grazing by sheep, cattle and horses. The intensity of grazing varies from severe cattle use with accompanying poaching, through moderate to heavy sheep grazing, often resulting in a tight species-poor turf to areas where grazing has been absent for a considerable time. The grazed saltmarshes include upper margins with sea rush *Juncus maritimus* and marsh-mallow *Althaea officinalis*, which are a particularly distinctive ecological feature of this site. Over grazing can lead to loss of rare plant species and affect bird breeding and feeding habitats and under-grazing can lead to a loss of plant diversity by competitive exclusion. Animal waste can contribute to water quality deterioration.

4.4 *Salicornia* and other annual colonising mud and sand

***Salicornia* and other annuals colonising mud and sand** are defined in the EU Habitats Interpretation Manual as;

“Formations composed mostly or predominantly of annuals, in particular Chenopodiaceae of the genus *Salicornia* or grasses, colonising periodically inundated muds and sands of marine or interior salt marshes. *Thero-Salicornietea*, *Frankenietea pulverulenta*, *Saginetea maritima*.”

Of the listed sub-types the Carmarthen Bay & Estuaries SAC includes examples of glasswort swards (*Thero-Salicornietalia*). This form of saltmarsh is widely distributed throughout coastal areas of the EU. In the UK it is widespread in the saltmarshes of England and Wales, but the area of this habitat type is restricted in Scotland and Northern Ireland because of a lack of new sediment for saltmarsh development. Four different plant communities are represented by this SAC habitat in the UK.

4.4.1 Range

This habitat feature is pioneer saltmarsh that colonises intertidal mud and sandflats in areas protected from strong wave action. It is an important precursor to the development of more stable saltmarsh vegetation. *Salicornia* and other annuals colonising mud and sand develops at the lower reaches of the saltmarsh where the plants are frequently flooded by the tide. It can also colonise open creek sides, depressions or pans within saltmarshes, as well as disturbed areas of upper saltmarsh.

Annual *Salicornia* saltmarsh or *Suaeda maritima* saltmarsh is scarce in the Burry Inlet but well represented on the Landimore-Llanrhidian marshes where sizeable stands form good sequences between pioneer and transitional marsh. These communities are scarce within the Three Rivers complex with small but representative stands of *Salicornia* on both the Taf and the Gwendraeth. The reason for the paucity of the *Salicornia* community is unclear but is probably related to particle size of the substrate: *Spartina* may have the advantage as the initial pioneer.

4.4.2 Structure and function

Salicornia grows on a wide variety of marine sediments in intertidal habitats, ranging from gravels and shelly sands, through silts to fine clays, and is invariably associated with saline, brackish or alkaline substrates. Although an early colonist of soft, unconsolidated sediments, the densest stands tend to be on firm silts and clays. The substrates of *Salicornia* span the tidal range and are often waterlogged for much or all of the time,

depending on elevation and drainage conditions. The saturated sediments are typically hypoxic and may develop low redox potentials, even in the surface layers and the plants may avoid root hypoxia by relatively shallow rooting. One consequence is that hydraulic forces generated by tidal flow, perhaps associated with scouring of the sediment and wave action, can be a major source of mortality for *Salicornia* seedlings at lower elevations on a saltmarsh.

Salicornia is extremely tolerant of regular flooding although growth of *S. europaea* is reduced by cultivation under continuous water-logging, in comparison with free drainage at the same salinity. As a halophyte, *Salicornia* is tolerant of exceptionally low water potentials in its root environment, whether they arise from salinity, drought or a combination of both.

Individual populations and taxa of *Salicornia* may be very sensitive to elevational variations associated with microtopography on the gradient from land to sea of tidal saltmarshes. Populations on the lower shore need to be more tolerant of prolonged submergence, tidal scour and water-logging, whereas those at high elevations may experience hypersalinity in summer.

Few grazers feed on the saltmarsh plants directly. In spring and summer, *Salicornia* spp. are highly productive and in autumn die back and decompose. Therefore, the majority of *Salicornia* spp. productivity, and presumably other vascular plant (*i.e.* *Suaeda maritima*) productivity, enter the food web as detritus. Benthic algae and microphytobenthos play an important role in cycling nutrients, and hundreds of species of bacteria, fungi, and microalgae may be attached to surfaces of vascular plants and sediment. These are grazed by meiofauna (*e.g.* protozoa, foraminifera, nematodes). Mature stands of *Salicornia* and their seeds can be an important food resource for passerine birds and geese. This pioneer saltmarsh habitat also provides sheltered nursery sites for several species of fish.

4.4.3 Typical species

The site is selected as representative of pioneer glasswort *Salicornia* spp saltmarsh in the south-west of the UK. It forms an integral part of the estuarine system, supporting extensive pioneer communities and contributing to a complete sequence of saltmarsh vegetation, including transitions to upper saltmeadow and to important sand dune habitats.

Although *Salicornia* and *Suaeda* are components of several of the communities within the Burry Inlet, stands composed principally of colonising annuals forming annual *Salicornia* saltmarsh or *Suaeda maritima* saltmarsh are scarce. In the Three Rivers complex *S. maritima* saltmarsh is restricted to a single location on the Gwendraeth and stands are fragmentary although typical even though the cover of *Suaeda* is rather low; the community is probably still developing. Associates are restricted to *Salicornia* and *Spartina* with a little *Halimione* and scattered tillers of *Puccinella*.

The *Salicornia* spp. present in the Carmarthen Bay & Estuaries SAC reputedly includes the nationally scarce *Salicornia pusilla* at unknown location(s). Also of note is *Spartina anglica* which is presently spreading along the north Gower coastline, occupying increasingly the niche vacated by *Salicornia*, because the southward migration of the channel has increased energy levels. Dunlin, for instance, prefers *Salicornia* to *Spartina* for foraging.

No information is currently available on the composition of fauna and other flora associated with pioneer saltmarsh communities although there are descriptions of species that are typically associated with *Salicornia* marshes.

A reduced marine fauna is usually present which may include the amphipod *Corophium volutator*, the ragworm *Hediste (Nereis) diversicolor* and often the mud snail *Peringia ulvae*. There are often algal films, including diatoms, and algal mats over the substrate surface, but vascular companions are usually very few. Scattered plants of *Puccinella maritima* and *Spartina anglica* occur frequently.

4.4.4 Natural processes

The location, character, and dynamic behaviour of the *Salicornia* and other annuals feature is governed by four physical factors: sediment supply, tidal regime, wind-wave climate and the movement of relative sea level. There are four elements necessary for the development and growth of a salt marsh: (1) a relatively stable area of sediment that is covered by the tide for a shorter period than the time it is exposed; (2) a supply of suitable sediment available within the period of tidal cover; (3) water velocities that are sufficiently low for some of the sediment to settle out; and (4) a supply of seeds or other propagules for the establishment of vegetation cover.

In temperate regions, such as the saltmarshes of Carmarthen Bay the growing season is generally 7-8 months, and the *Salicornia* is typically a summer-annual. Flowering occurs mainly from mid-August to mid-September and seed germination tends to coincide with low sediment salinities, in winter in Britain. Lower-marsh populations, such as *S. europaea*, tend to germinate earlier than upper marsh ones, e.g. *S. pusilla* (The lower limit of establishment of *Salicornia* on saltmarshes often appears to be set by the time necessary for the seedlings to penetrate the sediment and develop a ring of root hairs, in order to become fully anchored. A threshold period of tidal exposure of 2-3 days for rooting sufficient to resist tidal action on the low part of an estuarine marsh has been suggested.

4.4.5 Modifications as a result of human activity

Changes in the area of pioneer *Salicornia* may be due to migration of the main channel and vehicular erosion. *Spartina* often exhibits large inter-annual differences in extent. These are generally brought about by natural environmental conditions which at times can impede the germination, root-taking and subsequent growth of the annual *Salicornia* for example excessive wave action or submergence time. Modifications to the extent of *Spartina* can also be brought about by poaching by livestock, vehicular erosion or by tidal channels cutting into upper mudflats.

4.5 Large Shallow Inlets and Bays

Large shallow inlets and bays are defined in the EU Habitats Interpretation Manual as; "Large indentations of the coast where, in contrast to estuaries, the influence of freshwater is generally limited. These shallow indentations are generally sheltered from wave action and contain a great diversity of sediments and substrates with a well-developed zonation of benthic communities. These communities have generally a high biodiversity."

In the UK, there are several physiographic types of large shallow inlet and bay that meet the EC definition: embayments which are a type of marine inlet typically where the line of the coast follows a concave sweep between rocky headlands, sometimes with only a

narrow entrance to the embayment; fjords which are series of shallow basins connected to the sea via shallow and often intertidal sills; rias which are drowned river valley in an area of high relief (known as voes in Scotland).

The feature in this SAC is an embayment and is referred to as a large shallow bay in this document.

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:

- Intertidal mudflats
- Intertidal Underboulder Communities
- Mussel beds
- Peat and clay exposures
- *Arctica islandica*
- *Ostrea edulis*
- *Pleuronectes platessa*
- *Raja clavata*
- *Raja montagui*
- *Solea solea*

4.5.1 Range

Carmarthen Bay is a large shallow bay partially bound by rocky outcrops, with soft sediment communities occupying most of the Bay. It extends from Tenby and Caldy Island in the West to Worm's Head on the Gower peninsula in the east and covers approximately 43,492ha, comprising 6.5% of the UK resource and around 66% of the Carmarthen Bay & Estuaries SAC.

There are a variety of component habitats within Carmarthen Bay given the different seabed types which include mud, sand and rock. This includes a significant presence of one Annex 1 habitat (intertidal mudflats and sandflats) and three Annex II species which occur in the site (shad sp., river lamprey and sea lamprey). These are described separately.

4.5.2 Structure and function

The seafloor of Carmarthen Bay consists of a mixture of sediments although mostly fine sand. The outer / seaward side of the feature is more medium sand with occasional areas of coarse sand and muddy silt. A few rocky outcrops are present, the largest being off Small Ord Point, near Caldey Island. Mid-Flandrian peat beds are exposed as ledges at times along the northern and north-eastern boundary of the large shallow bay. The rocky intertidal areas around the bay vary from steep cliffs at Tenby to bedrock platforms at Saundersfoot and areas of mixed rock and sediment at Whiteford and Telpyn which are exposed to wave action and sand scour.

The physical conditions vary considerably throughout the bay with salinity ranging from low at the estuaries to fully marine. There are also gradients in wave action from sheltered to exposed, and in tidal currents which are strong around exposed headlands and sheltered elsewhere. There is an exchange of sediments with mudflat, sandflats, saltmarsh and dunes, all of which are dynamic environments.

The nutrient levels and levels of contaminants in the water column are unknown, but assumed to be low because of the hydrodynamic setting of Carmarthen Bay. Levels of contaminants within the sediment are also unknown, but assumed to reflect concentrations in overlying water. The status of the WFD water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales³⁶

4.5.3 Typical species

The main sublittoral biotope is associated with sand and non-cohesive muddy sand and generally dominated by small bivalve mussels. At the western end of Carmarthen Bay the fine sand supports abundant marine life, much of it buried. This included the brittlestar *Amphiura filiformis*, the necklace shell *Euspira catena*, the burrowing crab *Corystes cassivelaunus*, and the anemone *Sagartiogeton undatus*. There were also bivalve molluscs such as razor shells *Ensis* sp., gapers *Mya* sp., venus shells *Venus* sp. and otter shells *Lutraria lutraria*. Surface life included starfish *Astropecten irregularis*, brittlestars *Ophiura ophiura* and *O. albida*, the common whelk *Buccinum undatum*, reticulated dog whelk *Nassarius reticulatus*, small flatfish and gobies.

The most abundant group of organisms found within Carmarthen Bay sediments are polychaetes (accounting for over 50% of infauna), with molluscs and crustaceans also being abundant. Pembrey Sands at the mouth of the Loughor is dominated by the polychaete *Lanice conchilega*, but the polychaete *Spiophanes bombyx* is also found in large numbers in other areas of the bay. Other polychaetes commonly found are *Magelona filiformis*, *Nephtys cirrosa* and *Chaetozone setosa*. A number of molluscs are widespread in the sandy sediments of the Bay, including *Kurtiella bidentata*, *Abra alba* and *Chamelea gallina*.

Also occurring in the bay are amphipods and echinoderms such as the heart urchin *Echinocardium cordatum* and various brittlestars, including *Ophiura ophiura* that is found in large numbers in the bay. Starfish are also present throughout the bay, as are molluscs such as the small opisthobranch *Philine aperta* and the whelks *Buccinum undatum* and *Nassarius* sp.

The more varied stable areas of cobble and boulders just west of Woolhouse Rocks are colonised by large numbers of mussels *Mytilus edulis* and sea squirts *Molgula manhattensis*. Where sand scouring occurs hydroids such as *Sertularia argentea*, *Abietinaria abietina*, *Halecium halecinum*, *Hydrallmania falcata* and *Obelia longissima* dominate. At The Yowan there was a wide variety of other attached life including branching sponges such as *Haliclona oculata* and barnacles as well as crustaceans and fish such as bib and poor cod.

In the intertidal zone the cliffs at Tenby and north to Saundersfoot are dominated by lichens such as *Caloplaca* spp. and *Verrucaria* spp., barnacles *Semibalanus balanoides*, and mussels *Mytilus edulis* with patches of furoid algae *Fucus serratus* and kelps *Laminaria digitata* where the cliffs extend onto the lower shore. Sponges *Grantia compressa* and *Leuconia* sp. and shade-tolerant red seaweeds *Palmaria palmata*, *Plumaria plumosa* and coralline algal crusts occupy overhanging areas of bedrock on the lower shore.

³⁶ <http://waterwatchwales.naturalresourceswales.gov.uk/en/> relevant waterbodies for this site include: 3 rivers (Tywi, Gywyn & Gwendraeth), Loughnor, Loughnor Outer & Carmarthen Bay.

The bedrock platforms from Saundersfoot to Amroth are also exposed to wave action and sand scour and are dominated by lichens, barnacles and mussels but also coralline rock pools with daisy anemone *Cereus pedunculatus* on the mid shore, and sponges and anemones in overhangs, on the lower shore.

At Whiteford Point, much of the shore is dominated by a dense cover of *Mytilus edulis*, consolidating cobbles, pebbles and small boulders in some places together with a few large hydroid pools and numerous small pools are found in depressions. These beds can be ephemeral because of winter storms. The piddock communities are present in intertidal zones either within soft (Carboniferous) limestone along Tenby Cliffs and St Catherine's Island or in mid-Flandrian clays, along the Marros and Pendine coast and at Whiteford Burrows.

Rare and scarce species found within the large shallow inlet and bay feature (chiefly after unpublished data from Woolmer, 2003) include *Acanthocardia aculeata* (rare cockle), *Achaeus cranchii* (crab), *Atrina fragilis* (fan shell), *Dromia personata*, *Ostrea edulis* (native oyster), and *Padina pavonica* (brown alga). However, the records of *Atrina fragilis*, *Ostrea edulis*, *Dromia personata* and *Padina pavonica* date back to pre-1950, with no records since.

Carmarthen Bay is a known hotspot for the leatherback turtle and there are regular sightings. This has been linked to the abundance of their prey species *Rhizostoma octopus* which can reach large numbers in summer months.

Atlantic salmon *Salmo salar* and sea trout *Salmo trutta* are present in many of the rivers and coastal areas of the Bristol Channel with salmon runs in a number of watercourses draining into Carmarthen Bay, including the Rivers Taf, Tywi and Gwendraeth. The migratory European eel *Anguilla anguilla* is commonly found throughout Carmarthen Bay and its estuaries and the SAC appears to be an important nursery and feeding area for a number of fish, including Dover sole *Solea solea*, bass *Dicentrarchus labrax*, plaice *Pleuronectes platessa* and the dab *Limanda limanda*.

4.5.4 Natural Processes

The distribution, extent and shape of inlets and bays is a reflection of the underlying geology, with some structures of resistant rock, areas of rock amenable to erosion and zones of geological weakness. Sediment shores and submerged sediment plains are much more dynamic features subject to natural change influenced by factors such as tidal flow, tidal range, currents, weather conditions and aspect.

Shallow inlets and bays are sedimentologically linked with the two couplets of mudflat and saltmarsh, and beach/sandflat and dunes. There is generally an exchange of sediments between these dynamic environments by way of bi-directional sediment transport pathways.

The types of sediment and hard substrata habitats within large shallow inlets and bays are largely determined by the underlying geology and sedimentology, along with orientation and aspect and the influence of the prevailing physical conditions such as the degree of exposure to wave action and tidal currents. These factors, combined with the influence of others, such as water quality (including turbidity) and sediment chemistry, influence the

assemblages of marine species associated with the different habitats throughout large shallow inlets and bay.

Sediment granulometry and structure are primary factors in determining biological community structure. Sediment topography is the product of sediment structure and sediment transport determined by hydrodynamic process and these can vary with short and long-term natural cycles, climate influences and stochastic events. The variety of species in inlets and bays is often high as a result of wide habitat variety, the wide range of wave exposure, current strength, depth, light and substrate type, and presence of habitats that support high diversity.

4.5.5 Modifications as a result of human activity

The main modifications as a result of human activity for large shallow inlets and bays can be found in the sections on the main habitat feature encompassed within this feature; mudflats and sandflats as well as within the sections on the Annex II species which occur in the site (shad sp., river lamprey and sea lamprey).

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 Carmarthen Bay and Estuaries SAC are gravelly and clean sands.

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

- *Pleuronectes platessa*

- Solea solea

4.6.1 Range

The SAC includes the sandbank of Helwick Bank which is located in open water to the south of Worm's Head off the Gower Peninsula. The Bank covers an estimated area of around 7,865 ha and the computed average annual volume above the 25 m contour for the years 1993 to 2002 was of the order of 175m cubic metres. With a minimum of 171m cubic metres and a maximum of 178m cubic metres it is clear that the differences in volume from year to year can be of the order of millions of cubic metres.

4.6.2 Structure and function

Helwick Bank is a linear, very shallow, subtidal sandbank that is one of the most highly exposed to wave and tidal action of all the Welsh sandbanks. The Bank is oriented in an east-west direction and is approximately 12 km in length. It consists of two shoal areas (East and West Helwick), with a slightly deeper area between known as Helwick Swatch. The Bank is closely associated with the coastal headland of Port Eynon Point and the current flows around it. The local geology underlying and adjacent to the Helwick Bank, in particular the Carboniferous limestone bedrock of Port Eynon Point close to the bank, and the underlying flat surface of Lias bedrock, are important in determining the hydrodynamic regime, sediment dispersal and deposition and morphological evolution of the sandbank.

The seabed south of the Bank rises from around 32 m to between 3-4 m on the crests of the East and West Helwick shoals and around 6 m on Helwick Swatch. To the north of the Bank, the seabed falls away to a shallow flat area before rising once again to the coast. To the northwest, the Bank grades into the slightly deeper sand sheet of Carmarthen Bay, and to the south and east, the seabed deepens between 20 and 30 m.

The seabed sediments of the Helwick Bank area are predominantly uniform, medium fine sands with little or no fine or organic material. The more landward side of Helwick Bank is comprised of finer sands. To the south of the Bank, in deeper water, there are some uniform gravelly sands with no bedforms, and areas of irregular sand patches on gravel. There are sand waves along the flanks of the Bank indicating large-scale sand transport and an area of megaripples to the south of the Bank that merges to the west with an area of sand waves and gravelly sand. These ripples are superimposed on larger bedforms. The asymmetry of these sand waves (plus textural analysis and current modelling) indicate that all the bank has a clockwise sediment bedload circulation pattern, with flood dominant movement on its northern inshore side and ebb dominant movement on its southern offshore side. This circulation pattern is important in maintaining the overall geomorphology of the bank.

The salinity of the water column above the Helwick Bank and that of the interstitial sediment water is considered to be fully marine. The nutrient and contaminant levels in the water column are unknown, but assumed to be low because of the hydrodynamic setting of the Helwick Bank. Sediment nutrient and contaminant levels are also unknown, but assumed to reflect concentrations in overlying water. The oxygen content of the water column above the Helwick Bank and that of the interstitial sediment water is considered to be fully saturated. The status of the WFD water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales³⁷

³⁷ <http://waterwatchwales.naturalresourceswales.gov.uk/en/> relevant waterbodies for this site include: 3 rivers (Tywi, Gywyn & Gwendraeth), Loughnor, Loughnor Outer & Carmarthen Bay.

The Helwick Bank complex lies within known spawning and nursery grounds for lemon sole *Microstomus kitt*, and within nursery areas for plaice *Pleuronectes platessa*, and whiting *Merlangius merlangus*. The area is also believed to be a nursery area of considerable importance for turbot *Scophthalmus maximus*, as evidenced by the presence of juveniles of this species (SWSFC, pers. comm.).

4.6.3 Typical species

The animal communities found in and on Helwick Bank are mostly characteristic of mobile sands and gravels with the exception of those to the south of the bank and many species spend most of their time wholly or partly buried in the sediment.

The sublittoral coarse sediments, mobile sand and gravels on the toe of the bank, the southern part of West Helwick and main part of East Helwick have communities dominated by *Hesionura elongata*, *Nephtys cirrosa* and *Protodriloides chaetifer*. The communities on the north of the bank and in Helwick Channel are characteristic of those on sublittoral sand and non-cohesive muddy sand, with sparse fauna in infralittoral mobile clean sand. They include *Gastrosaccus spinifer*, *Nephtys cirrosa* and *Pontocrates arenarius*. The sublittoral coarse sediments, on the south of the bank are dominated by *Bodotria arenosa*, *Lanice conchilega*, *Lagis koreni*, *Mediomastus fragilis*.

The sandbanks show an increasing species richness in deeper waters. The polychaetes *Hesionura elongata* and *Nephtys cirrosa*, and the archiannelid *Protodriloides chaetifer* are all common across the Helwick Bank, and the sediments are dominated in sections by *Nephtys cirrosa* and the mysid *Gastrosaccus spinifer*. All four species are common to fine-medium sand habitats, particularly those subject to high water and sediment movements and where species richness is low. Infaunal samples found an average of 41 species per grab on the Helwick Bank (East) and 37 species per grab on the Helwick Bank (West). Species numbers from two stations on the seaward side of the Helwick Bank were highest, i.e. 102 and 103 species for Helwick Bank (East) and Helwick Bank (West) respectively. These two stations in deeper water, with more stable sandy substrates, are therefore considerably more species rich than the shallow water, high energy, sites.

Fish use the Helwick Bank in a number of ways including spawning, nursery and feeding. Nine species of fish were caught during a 2001 survey with the catch dominated by weaver fish *Echiichthys vipera*, spotted ray *Raja montagui*, grey gurnard *Eutrigla gurnardus*, and sand sole *Pegusa lascaris*, followed by plaice *Pleuronectes platessa*, and turbot *Scophthalmus maximus*. Blonde ray *Raja brachyura*, and cuckoo ray *Leucoraja naevus*, are also caught in this area (SWSFC, pers. comm.). Some ray species are likely to spawn on the sandbank, for instance thornback ray *Raja clavata*, blonde ray *Raja brachyura*, small-eyed ray *Raja microoculata* and spotted ray *Raja montagui*. The area is also used as a nursery ground, possibly by thornback, small-eyed and spotted rays, because they all favour inshore nursery areas. The extent of the area used by rays is unknown, although research has shown that juvenile thornback rays appear to be highly site-specific, remaining close to the coast for several years, and thornback rays are probably ubiquitous in sand and gravel coastal waters.

Sandeels *Ammodytes tobianus* are also thought to spawn on Helwick Bank and the surrounding, seabed. They are a common inshore species and are likely to occur along the length of the Bank and surrounding sandy substrates to a depth of around 30 m. They play

a fundamental role in the local marine food web: bass *Dicentrarchus labrax*, whiting *Merlangius merlangus*, cod *Gadus morrhua*, sole *Solea* spp., plaice *Pleuronectes platessa*, brill *Scophthalmus rhombus*, and flounder *Platichthys flesus*, are all known to feed on sandeels. These in turn attract larger predators. Notable species include the southern cumacean *Cumopsis fagei* which has been identified from several stations on Helwick Bank and which is not frequently recorded from British waters, the bryozoan *Odontoporella lata* at the northernmost limit of its distribution, the gastropod *Parthenina interstincta* which is rare in the region, and the polychaete *Thoracophelia flabellifera* which has a limited number of recordings from UK waters. Some of these species may be under-recorded, rather than truly rare and therefore the information should be treated with caution, until further evidence is available.

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

The Helwick Bank forms a key component of the Bristol Channel sediment system. This larger circulatory system appears to be in gradual decline as sediment is stripped from its bedload parting in the east and lost to the Celtic Sea in the west; The Helwick Bank is an open system both receiving and losing sand to adjacent areas but whose inputs depend primarily on movements from the east, which appear to be in decline.

Annual monitoring data demonstrates a net loss of sand from the Helwick Bank open system, amounting to some 300,000 m³ per year from the volume contained above the -15m chart datum contour. This net loss is primarily due to natural processes but losses due to aggregate extraction in the past have formed a significant proportion of the volume lost. Although it is not possible to distinguish between the processes of natural and artificial losses it is nevertheless clear that, in strictly volumetric terms, losses due to aggregate extraction have not been replenished on the upper levels of the Helwick Bank.

NRW considers with a very high degree of confidence that the sandbank is in morphological decline. Although this is mainly due to natural processes, it is clear that any further extraction will exacerbate the deterioration of the morphology of the bank and its associated FCS. Furthermore, the behaviour of the sandbank macro-topography, in particular its progressive / ongoing lowering of sandbank crest level relative to the tidal frame, will inevitably result in impacts on the structure, function, and ultimately, on the typical species of the sandbank habitat. The conservation objectives integrate the physical and biological characteristics, and all are of equal importance.

Sea level rise is not considered to have had a significant impact on the identification of sediment losses from the Helwick Bank. Sea level rise has averaged 0.00076 m per year over the past 200 years, an order of magnitude less than the average vertical fall in surface elevation of the crest of the Bank.

4.7 Allis shad *Alosa alosa* and twaite shad *Alosa fallax*

Shad are herring-like fish that spend most of their adult lives in the sea but spawn in rivers (or, occasionally, in the upper reaches of estuaries) in early summer. Breeding populations occur in several British rivers, the most important populations being in the Tywi, Usk, Wye and Severn. They migrate through estuaries in March-May on their way to the spawning grounds, with a water temperature of 10-12°C acting as a trigger for migration. Most adults die after spawning but a proportion of UK fish are known to repeat spawn: these presumably migrate back to sea immediately after spawning in June-July.

Juveniles generally migrate to the estuary between August and October, where they spend some time feeding. Further seaward migration is triggered by falling temperatures in winter, but it is possible that at least a proportion of the juvenile fish overwinter in the estuary. In their first spring, juveniles make an onshore migration to the estuary and inshore waters³⁸. Older fish are typically found in shoals in deeper water and are capable of migrating in excess of 1000km. The principal feeding grounds of Welsh shad are unknown but relatively frequent catches of subadult shad by fishermen off the Devon and Cornwall coasts in both the Bristol and English Channels³⁹ suggests that these may be important.

The two British species are closely related and produce fertile hybrids. Adult allis shad feed predominantly on marine crustaceans such as mysids, whereas adult twaite shad predominantly take small fish such as sprats. Juveniles of both species feed on zooplankton when small and larger crustaceans such as mysids as they grow.

At all stages of their life cycle, shad are pelagic fish, and in estuaries the juveniles predominantly occur in the surface layers of the water column. Adults have been recorded at depths of up to 150m, though twaite shad also favour shallower waters <50m deep⁴⁰.

4.7.1 Population dynamics

The River Tywi is one of the only three rivers in Wales where there are substantial spawning populations of shad. There is evidence of a high level of past and / or present hybridisation in Tywi shad, though the reasons for this are unknown⁴¹.

Although shad spawning in tidal waters has been recorded elsewhere, tidal spawning has not been recorded in the SAC. It is therefore assumed that most of the juvenile shad using the site came from in the upstream Afon Tywi SAC. However, it is also possible that older juveniles from the Wye, Usk and Severn use the Carmarthen Bay and Estuaries SAC as nursery habitat.

Monitoring shads presents a significant challenge. The current approach relies on kick sampling of the eggs during the spawning season, which provides a semi-quantitative estimate of the extent and abundance of spawning. These data are also used to report on the status of the marine site. Stock-recruitment modelling indicates that recruitment is

³⁸ Aprahamian *et al.* (2002)

³⁹ Hillman (2002)

⁴⁰ Taverny & Elie (2001)

⁴¹ Hardouin *et al.* (2013)

strongly temperature dependant, with recruitment being much stronger in the lower river and in warm years⁴².

4.7.2 Range

All shad that spawn in the Afon Tywi SAC must pass through the Carmarthen Bay & Estuaries SAC to spawn, and juvenile fish from this population depend on the estuarine and inshore habitat in the marine SAC both as a migration route and for nursery habitat.

Peak abundance of adult fish within the SAC occurs between March and May, just prior to the spawning migration. After spawning, surviving fish can be expected to re-enter the estuary in June and July. Adult fish tend to migrate by day at high tide, utilising deeper channels during migration.

Juveniles may be present in the SAC at any time of year, with peaks in spring and autumn corresponding to the inshore migration of older juveniles and the downstream migration of young-of-year fish respectively.

4.7.3 Habitat and species

Shad migrate through the waters of the SAC to reach spawning sites in the River Tywi. The Taf-Tywi-Gwendraeth Estuary is also important as a nursery area and it is likely that shad feed in the inshore waters of Carmarthen Bay. Juvenile shad have also been recorded from the Burry Inlet.

The marine habitat requirements of shad in the Carmarthen Bay and Estuaries have not been studied, but data from elsewhere indicate that important habitats include the salt wedge at the head of the tide⁴³ and warm shallow inshore waters and estuaries⁴⁴, both of which are extensive within the SAC. Adult twaite shad are likely to feed mainly off-shore, outside the SAC boundary and including in Pembrokeshire Marine SAC.

4.7.4 Modifications as a result of human activity

The principal issues affecting the shad populations in the SAC relate to the management of the Afon Tywi SAC. However, the lack of data on the use of the SAC by shad makes it very difficult to identify specific marine pressures and threats.

In the freshwater environment, shad are very sensitive to physical instream structures such as dams and barrages, and this is also likely to apply in the marine environment. In this context, marine energy development such as tidal lagoons is likely to be a significant threat.

Shad are sometimes taken by trawlers and sea anglers but there is no evidence of a consequent threat to their populations.

4.8 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

⁴² Knights (2014)

⁴³ Maitland & Hatton-Ellis (2003)

⁴⁴ Aprahamian *et al.* (2002)

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 cetaceans⁴⁵. Juvenile sea lampreys have been suggested to prefer migratory species (including shad) as prey in freshwater and estuarine environments, perhaps due to their larger size⁴⁶. 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 land⁴⁷ and at depths of up to 1000m.

4.8.1 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 Carmarthen Bay & Estuaries SAC are based on condition monitoring of the Afon Tywi SAC, which assesses the extent and density of juvenile lampreys. Video and hydroacoustic fish counter data from the Afon Tywi have provided estimates of adult sea lamprey run (e.g. Griffiths & Clabburn 2009), though due to the time-consuming nature of this work it has not been possible to carry it out every year.

Lampreys do not home to their natal river⁴⁸, so lampreys using the Carmarthen Bay and Estuaries 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, Severn Estuary, Afonydd Cleddau and Pembrokeshire Marine should be seen as linked to Carmarthen Bay & Estuaries.

4.8.2 Range

Adult river lampreys migrate through the SAC to reach the River Tywi on their spawning migration, entering freshwater between October and December⁴⁹. 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 River Tywi. Lampreys from the Rivers Usk and Wye are also quite likely to 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

⁴⁵ Silva *et al.* (2014)

⁴⁶ Silva *et al.* (2013)

⁴⁷ Kelly & King (2001)

⁴⁸ Bergstedt & Seelye (1995)

⁴⁹ Maitland (2003)

10°C and continues until temperatures reach 18°C. Juvenile sea lampreys migrate downstream between December and June⁵⁰ 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.

4.8.3 Habitat 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 abundant during the winter in Carmarthen 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 suggested⁵¹.

4.8.4 Modifications as a result of human activity

There are no barriers to migration within the marine SAC.

4.9 Otter (*Lutra lutra*)

The otter *Lutra lutra* is a semi-aquatic mammal which occurs in a wide range of ecological conditions, including inland freshwater and coastal areas. Populations in coastal areas use shallow, inshore marine areas for feeding but also require freshwater for bathing and terrestrial areas for resting and breeding holts. Coastal otter habitat ranges from sheltered wooded inlets to more open, low-lying coasts. Inland populations utilise a range of running and standing freshwaters. These must have an abundant supply of food together with suitable habitat, such as vegetated riverbanks, islands, reed beds and woodland, which are used for foraging, breeding and resting.

At present, the majority of the otter population in Great Britain occurs in Scotland, with a significant proportion of this number being found in the north and west of the country. Other strong populations survive in Wales and Ireland. Recent surveys suggest that the otter population is recovering well and recolonising parts of its former range. While the SAC series makes a contribution to securing favourable conservation status for this Annex II species, wider countryside measures, in particular implementation of the UK's Biodiversity Action Plan⁵², are important to its conservation in the UK.

4.9.1 Population dynamics

The otter population in Wales is increasing and there has been an increase in locations used by otters. The otters using the site are part of the southwest Wales sub-group. The overall proportion of positive records from sample sites within this sub-group area in the 2010/11 Otter Survey of Wales was 90%. The Tywi hydrometric area showed a continued improvement in the total number and proportion of positive sites from 2002 to 2009-10, having an additional 17 positive sites, an increase from 76% to 94%⁵³. Although an

⁵⁰ 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.

⁵¹ Silva *et al.* (2014)

⁵² The reviewed Species Action Plan for otters in Pembrokeshire: <http://ukbars.defra.gov.uk/project/show/36401>

⁵³ Strachan (*in prep*)

increase in the number of positive sites may not necessarily equate to an increase in the number of otters present it appears that otter populations are recovering well.

Little is known about otter activity in the site or about their population dynamics. There is no data to show change in age structure, sex ratio structure or in cub production. A study of persistent organic pollutants and indicators of otter health in 2013⁵⁴ identified several indicators of male reproductive health that give cause for concern. The Otter Project runs a long term environmental surveillance scheme, using otters found dead to investigate contaminants, disease, and population biology across the UK⁵⁵.

4.9.2 Range

There was a high percentage occupation of the sites sampled in the Tywi and Loughor and it is likely that these catchments have reached close to carrying capacity⁵⁶.

The coast within the SAC is well supplied with rivers and streams and it is highly likely that otters travel from one watercourse to another along the coast. Otters living on the coast must have access to freshwater streams and pools for drinking and washing.

4.9.3 Habitat and species

Results from 2010⁵⁶ indicate that although the estuaries of the Taf, Tywi and Loughor are well used by otters, habitat availability (both resting and breeding sites) on coastal & estuarine fresh water streams is generally poor. Lack of resting sites was particularly highlighted for Pendine Marsh. Only one potential breeding site was found close to the coast on the three coastal stretches, at West House on the Pendine Marshes. In contrast, 10 potential breeding sites were found in the 4 estuaries. Opportunities to create otter habitat, mostly for resting sites, were identified at 14 sites, in both the coastal stretches and estuaries.

Coastal otters can hunt as far as 100 m offshore in water over 10 m deep, but most feeding is done much closer to shore in water less than 3 m deep. Studies on prey species taken by coastal otters in Scotland and elsewhere indicate that, fish formed more than 90 % of the diet. Other important non-fish prey items taken include crabs and sea urchins, although at a lower level in relation to their abundance than fish species. The different studies of otter diet show that the abundance of different prey items may be highly seasonal. The main hunting areas for otters on the coast are largely determined by the habitat preferences of prey species.

Over most of their range, otters are nocturnal or diurnal, probably due mainly to disturbance and persecution. When otters are not active, otters may sleep in a variety of resting places known as a den, holt or couch. These can be holes in the ground, under tree roots, within rock piles, dense scrub or in quite open places. We currently do not know where otters rest within the SAC due to their secretive nature and current lack of survey work around the coast.

4.9.4 Modifications as a result of human activity

The marine and estuarine environments within the Carmarthen Bay & Estuaries SAC provide otters with an abundant food resource. However, this can only be fully exploited by

⁵⁴ Kean *et al.* (2013)

⁵⁵ Cardiff University Otter Project (CUOP), <http://www.otterproject.cf.ac.uk/>

⁵⁶ Liles (2010)

otters if fresh water streams provide resting and breeding sites close to the sea and estuaries, and if access between streams and coast/estuaries is easy and does not put otters at risk⁵⁷.

Access for otters between coastal streams and the coast was recorded as “difficult” at three sites⁵⁷. At Tenby otters must cross the railway line; at Saundersfoot, tidal doors prevent access into the upper harbour and a long culvert pipe runs under part of the town and the main road; and at Amroth Castle the stream culvert pipe under the road is situated 2m above the beach, so that otters must cross the road. These modifications to otter movement were made before the site was designated.

Four places where there are physical barriers that prevent or deter otter travel (Tenby to Ragwen Point (2 locations), Loughor Estuary (2 locations)) have been identified⁵⁷. Two areas of high concern and two areas of medium concern in Carmarthenshire have also been identified⁵⁸. There are otter road death sites that are a concern near to the marine SAC with Commissioner’s Bridge, at Kidwelly a top priority for action.

⁵⁷ Liles (2010)

⁵⁸ Wilkinson & Chadwick (2012).

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 more accessible 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 Carmarthen Bay and Estuaries European marine site

Our vision for the Carmarthen Bay Special Area of Conservation (SAC), Carmarthen Special Protection Area (SPA) and Burry Inlet SPA is one of high quality marine environments, where the protected habitats and species of the sites 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 sites and where use of the marine environment is undertaken sustainably.

5.2 Conservation objectives for the Carmarthen 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
- Estuaries
- Mudflats and sandflats not covered by seawater all the time
- Large shallow inlets and bays
- Atlantic salt meadows
- *Salicornia* and other annuals colonising mud and sand

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.

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.

For **Atlantic saltmeadows** this includes the morphology of the saltmarsh creeks and pans.

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 health,
- 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

- Otter *Lutra lutra*
- Allis shad *Alosa alosa*
- Twaite shad *Alosa fallax*.
- River lamprey *Lampetra fluviatilis*
- Sea lamprey *Petromyzon marinus*

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;

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

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:

- 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.
- For **otter** there are sufficient sources within the SAC and beyond of high quality freshwater for drinking and bathing.

5.3 Conservation objectives for the Burry Inlet and Carmarthen Bay special protection areas.

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.

- a) The numbers of all SPA bird species are stable or increasing.
- b) The abundance and distribution of suitable prey are sufficient and appropriate to support the numbers of all SPA bird species.
- c) All SPA birds are allowed to inhabit their feeding grounds and resting areas with minimum disturbance, and are allowed to move unhindered between them.
- d) All states of the Conservation Objectives for the supporting habitats and species, subject to natural processes, are fulfilled and maintained in the long-term.
- e) The management and control of activities or operations likely to be of significant effect to the oystercatchers, is appropriate for maintaining the feature at FCS and is secure in the long-term.

Supporting habitats for bird species of the Burry Inlet SPA include:

- Estuaries
- Mudflats and sandflats not covered by seawater at low tide
- Atlantic salt meadows
- *Salicornia* and other annuals colonising mud and sand

'Large shallow inlets and bays' are the supporting habitat for the common scoter of the Carmarthen Bay SPA.

5.3.1 Species Features

Burry Inlet SPA

- curlew *Numenius arquata*
- dunlin *Calidris alpina alpina*
- grey plover *Pluvialis squatarola*
- knot *Calidris canutus*
- oystercatcher *Haematopus ostralegus*
- pintail *Anas acuta*
- redshank *Tringa totanus*
- shelduck *Tadorna tadorna*
- shoveler *Anas clypeata*
- teal *Anas crecca*
- turnstone *Arenaria interpres*
- wigeon *Anas penelope*

Carmarthen Bay SPA

- common scoter *Melanitta nigra*

5.4 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, 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 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 <u>reduction</u> 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 site⁵⁹.

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

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.

⁵⁹ Uncertainty should not result in a conclusion of no adverse effect on site integrity.

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

Activity	Relevant factors		Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
DOCKS, MARINAS & SHIPPING															
Dock, harbour & marinas structures: Construction* <i>Small to medium-scale dock / port facilities at Llanelli, Burry Port, Tenby & Saundersfoot. No facility as yet that can be classified as 'Marina', but future developments are likely to focus on existing facilities at these locations.</i>	<u>Geophysical regime:</u> modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate <u>Fundamental environmental parameters:</u> changes to available oxygen; turbidity; suspended sediments <u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants <u>Physical disturbance:</u> displacement, crushing, abrasion, smothering visual, noise	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution:</u> loss of / reduction in habitat extent; reduction in habitat distribution; particularly intertidal habitats. <u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> 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. <u>Operation specific information required:</u> location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information.	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Dock, harbour & marinas structures: Maintenance* <i>As above</i>	<u>Environmental quality:</u> addition of toxic and non-toxic contaminants (biocides, oxidising and reducing agents, petrochemicals, suspended particulates) <u>Physical disturbance:</u> displacement, crushing, abrasion, smothering visual, noise	✓	✓	✓	✓	✓		✓	✓	✓		✓	<u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> likely decrease in species diversity and effects to population dynamics dependant on location and extent of proposed maintenance and materials used. <u>Operation specific information required:</u> 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 (including assessment of cumulative effects in association with others plans and projects, where necessary).	

Activity	Relevant factors		Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Dredging: capital * <i>None at present. (c.f. aggregate extraction; also see dredge spoil disposal)</i>	<u>Geophysical regime:</u> modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate <u>Fundamental environmental parameters:</u> changes to available oxygen; turbidity; suspended sediments <u>Environmental quality:</u> increased suspended nutrients; remobilisation of toxic & non-toxic contaminants (increasing bioavailability) <u>Physical disturbance:</u> displacement, abrasion, smothering, visual, noise <u>Other factors:</u> removal of biota	✓	✓	✓	✓	✓		✓	✓	✓			<u>Structure & function:</u> 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 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. <u>Conservation status of typical species & species features:</u> 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). <u>Operation specific information required:</u> <i>location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).	
Dredging: Maintenance* <i>Extent unknown. Approaches and navigation channel to Burry Port were dredged in 2007.</i>	<u>Geophysical regime:</u> modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate <u>Fundamental environmental parameters:</u> changes to available oxygen; turbidity; suspended sediments <u>Environmental quality:</u> increased suspended nutrients; toxic & non-toxic contaminants <u>Physical disturbance:</u> displacement, abrasion, smothering, visual, noise <u>Other factors:</u> removal of biota	✓	✓	✓	✓	✓		✓	✓	✓			<u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> 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). <u>Operation specific information required:</u> <i>location, extent, scale, timing and duration; frequency of operation and proximity to healthy populations for recruitment; relevant location-specific biotic and abiotic information</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).	
Shipping: vessel traffic <i>No data available</i>	<u>Geophysical regime:</u> vessel wash - substrate erosion, local modification of wave exposure regime <u>Fundamental environmental parameters:</u> turbidity <u>Physical disturbance:</u> collision, noise,	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	<u>Structure & function:</u> 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.	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
	visual												<p><u>Conservation status of typical species & species features:</u> 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).</p> <p><u>Operation specific information required:</u> 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); relevant location-specific biotic and abiotic information</p>	
<p>Shipping: Mooring*</p> <p><i>Potential exists, but no data available.</i></p>	<p><u>Geophysical regime:</u> local alteration / loss of substrate; local modification of sediment transport</p> <p><u>Physical disturbance:</u>, displacement, crushing, & abrasion</p>	✓	✓			✓							<p><u>Structure & function:</u> 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.</p> <p><u>Conservation status of typical species & species features:</u> 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).</p> <p><u>Operation specific information required:</u> 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</p>	Treat new mooring developments as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
<p>Shipping: anchoring</p> <p><i>No data available.</i></p>	<p><u>Geophysical regime:</u> local modification of substrate structure & sediment transport</p> <p><u>Physical disturbance:</u> crushing, abrasion & displacement.</p>	✓	✓			✓							<p><u>Structure & function:</u> 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.</p> <p><u>Conservation status of typical species & species features:</u> 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).</p> <p><u>Operation specific information required:</u> location, extent, frequency, timing and duration; size/types of anchor(s); proximity to sensitive</p>	Treat new mooring developments as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
													<i>habitats/communities</i>	
Shipping: Vessel maintenance (incl. antifouling) <i>Not known in site.</i>	<u>Environmental quality:</u> addition of toxic & non-toxic contaminants - (organo-metals, biocides, oxidising and reducing agents, petrochemicals); organic enrichment	✓	✓	✓	✓	✓		✓	✓	✓			<u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> 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). <u>Operation specific information required:</u> location, extent, scale, frequency, timing and duration; types of antifouling compounds and other materials employed, disposal methods used; proximity to sensitive habitats/communities/populations.	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).
Shipping: Ballast water discharge <i>Ballast water convention now in force.</i>	<u>Environmental quality:</u> organo-metals (antifoulants) <u>Other factors:</u> introduction of non-native species	✓	✓	✓	✓	✓	✓	✓					<u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> 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. <u>Operation specific information required:</u> 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. Seek advice from relevant agency (e.g. NRW).
Shipping: Refuse & sewage disposal <i>Presumed not to occur within site. Potential exists for effects from shipping transiting</i>	<u>Environmental quality:</u> addition of toxic (metals, synthetic organic compounds, microbial pathogens) & non-toxic (nutrients, inert particulates and materials) contaminants. <u>Physical disturbance:</u> entanglement, smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> effects on species variety, population dynamics, physiological health in species	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
<i>offshore in Bristol Channel.</i>													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. <i>Operation specific information required: location, extent, scale, frequency, timing and duration; types and toxicity of waste; relevant location-specific biotic and abiotic information</i>	
Shipping: operational discharges <i>Presumed not to occur within site. Potential exists for effects from shipping transiting offshore in Bristol Channel.</i>	<u>Environmental quality:</u> addition of toxic & non-toxic contaminants particularly hydrocarbons; organic enrichment <u>Physical disturbance:</u> smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function:</u> elevation of water (and sediment) contaminant and / or nutrient burden. <u>Conservation status of typical species & species features:</u> effects on species variety, composition, population dynamics & physiological health in species sensitive to hydrocarbons, organo-metal compounds, biocides, bleaches etc.; nutrient enrichment <i>Operation specific information required: location, extent, scale, frequency, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information</i>	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).
Shipping: accidents - may be associated with cargo / bunkers discharges <i>No data since Sea Empress Oil Spill.</i>	<u>Geophysical regime:</u> local modification of substrate structure & topography <u>Environmental quality:</u> addition of toxic & non-toxic contaminants <u>Physical disturbance:</u> displacement, amputation, crushing abrasion; visual; noise	✓	✓	✓	✓	✓				✓	✓	✓	<u>Structure and function:</u> physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment) hydrocarbon contaminant burden. <u>Conservation status of typical species & species features:</u> local effects on populations of species sensitive to physical impacts &/or hydrocarbon contamination; effects on species variety, abundance, dynamics, physiological health. <i>Operation specific information required: location, extent, scale, timing and duration; type, amount and toxicity of discharges; relevant location-specific biotic and abiotic information</i>	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).
Shipping: accidents - fuel oil & / or petrochemical discharges <i>No data since Sea Empress Oil Spill.</i>	<u>Environmental quality:</u> addition of toxic & non-toxic contaminants particularly petrochemicals <u>Physical disturbance:</u> smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function:</u> 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) <u>Conservation status of typical species & species features:</u> lethal and sub lethal physiological effects on species sensitive to hydrocarbons; effects on population variety, abundance, dynamics, physiological health. <i>Operation specific information required: location, extent, scale, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information</i>	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).
Shipping: accidents – non-	<u>Geophysical regime:</u> local modification of or addition to substrate <u>Environmental quality:</u> addition of toxic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function:</u> elevation of water and sediment contaminant burdens; decrease in habitat quality. <u>Conservation status of typical species & species features:</u> lethal and sub	Review, revise or establish management practices and spatial, temporal & technical

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
<p>petrochemical cargo losses / discharges</p> <p><i>Rare; most recent in February 2008 when a container containing acetic anhydride came aground at Paviland Bay near Pitton Green (South Gower).</i></p>	<p>& non-toxic contaminants - potentially wide range of organic & inorganic materials & particulates.</p> <p><u>Physical disturbance</u>: displacement, amputation, abrasion, smothering</p>												<p>lethal physiological effects on species sensitive to discharge; effects on population variety, abundance, dynamics, physiological health.</p> <p><i>Operation specific information required: location, extent, scale, timing and duration; type, amount and toxicity of discharge; relevant location-specific biotic and abiotic information.</i></p>	<p>operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).</p>
<p>Shipping: accidents - salvage operations</p> <p><i>No data available.</i></p>	<p><u>Geophysical regime</u>: local modification of or addition to substrate</p> <p><u>Environmental quality</u>: addition of toxic & non-toxic contaminants - petrochemicals, synthetics & metals debris</p> <p><u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, noise; visual</p>	✓	✓	✓	✓	✓				✓	✓	✓	<p><u>Structure and function</u>: physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment) contaminant burdens.</p> <p><u>Conservation status of typical species & species features</u>: local effects on populations of species sensitive to physical impacts &/or potential contaminants; effects on species variety, abundance, dynamics, physiological health.</p> <p><i>Operation specific information required: location, extent, scale, timing, duration and nature; likely effects and outcome; relevant location-specific biotic and abiotic information</i></p>	<p>Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).</p> <p>Provide environmental advice to salvage managers and salvors.</p>
CIVIL ENGINEERING														
<p>Construction*</p> <p><i>Widespread along the north side of Burry Inlet, with current construction hotspots at Loughor, Llanelli and Burry Port.</i></p>	<p><u>Geophysical regime</u>: modification of substrate, hydrodynamic regime & sediment transport</p> <p><u>Fundamental environmental parameters</u>: potentially acute effects on any component factors, potentially chronic effects particularly on suspended particulates / turbidity</p> <p><u>Environmental quality</u>: addition of toxic & non-toxic contaminants - particulates, synthetics & metals debris, petrochemicals</p> <p><u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, smothering, noise; visual</p>	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	<p><u>Extent & distribution</u>: loss of / reduction in habitat extent; reduction in habitat distribution; particularly intertidal habitats.</p> <p><u>Structure & function</u>: 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</p> <p><u>Conservation status of typical species & species features</u>: direct loss or modification of species variety, extent, distribution, population sizes;</p>	<p>Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).</p>

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
													indirect modification of population structure, physiological health, reproductive capacity. <i>Operation specific information required: location, extent, scale and nature of construction; timing and duration of operation; relevant location-specific biotic and abiotic information</i>	
Land claim *# <i>Past extensive reclamation of saltmarshes along the southern shoreline of the Burry Inlet and along the Taf Estuary. No proposals at present.</i>	<u>Geophysical regime</u> : modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u> : turbidity <u>Environmental quality</u> : toxic & non-toxic contaminants <u>Physical disturbance</u> : displacement, amputation, crushing, abrasion, smothering, noise, visual	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	<u>Extent & distribution</u> : loss of / reduction in habitat extent; reduction in habitat distribution. <u>Structure & function</u> : modification of physical structure and morphology; modification of hydrodynamic, sediment transport and turbidity regimes, and water and sediment chemistry; addition of contaminants <u>Conservation status of typical species & species features</u> : 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. <i>Operation specific information required: location, extent and scale of reclamation; timing and duration of operation; relevant location-specific biotic and abiotic information.</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Coast protection: hard defence (sea walls / breakwaters)*# <i>Locally extensive; comprehensively mapped. Worms Head – St Govans. See relevant shoreline management plan</i>	<u>Geophysical regime</u> : modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u> : suspended sediments, turbidity <u>Environmental quality</u> : remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u> : displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	<u>Extent & distribution</u> : potential loss of / reduction in habitat extent. <u>Structure & function</u> : 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 <u>Conservation status of typical species & species features</u> : 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. <i>Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</i>	Treat as plan or project as appropriate, taking into account long term management requirements and predicted climatic impacts.
Coast protection: hard defence (railways)*# <i>Locally extensive; coastal tracks straddle the north coast of the Burry Inlet</i>	<u>Geophysical regime</u> : modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u> : suspended sediments, turbidity <u>Environmental quality</u> : remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u> : displacement,	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	<u>Extent & distribution</u> : potential loss of / reduction in habitat extent. <u>Structure & function</u> : 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 <u>Conservation status of typical species & species features</u> : 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	Treat as plan or project as appropriate, taking into account long term management requirements and predicted climatic impacts.

Activity	Relevant factors		Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
														<i>Information necessary to further refine / tailor advice to specific operations</i>	
between Llanelli and Burry Port, and between Kidwelly and Ferryside. See relevant shoreline management plan	amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime													coastlines. <i>Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</i>	
Coast protection: soft defence*# Locally extensive; comprehensively mapped. Worms Head – St Govans. See relevant shoreline management plan	<u>Geophysical regime</u> : modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u> : suspended sediments, turbidity <u>Environmental quality</u> : remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u> : displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	✓							<u>Extent & distribution</u> : potential loss of / reduction in habitat extent. <u>Structure & function</u> : 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 <u>Conservation status of typical species & species features</u> : 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. <i>Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</i>	Treat as plan or project as appropriate, taking into account long term management requirements and predicted climatic impacts.
Coast protection: groynes*# Locally extensive; comprehensively mapped. Worms Head – St Govans. See relevant shoreline management plan	<u>Geophysical regime</u> : modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u> : suspended sediments, turbidity <u>Environmental quality</u> : remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u> : displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	✓							<u>Extent & distribution</u> : potential loss of / reduction in habitat extent. <u>Structure & function</u> : 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 <u>Conservation status of typical species & species features</u> : 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. <i>Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</i>	Treat as plan or project as appropriate, taking into account long term management requirements and predicted climatic impacts.
Coast protection: beach replenishment*# Localised: Tenby and Saundersfoot as	<u>Geophysical regime</u> : modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u> : suspended sediments, turbidity <u>Environmental quality</u> : remobilisation of	✓	✓	✓	✓	✓								<u>Extent & distribution</u> : potential loss of / reduction in habitat extent. <u>Structure & function</u> : 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 <u>Conservation status of typical species & species features</u> : direct loss or modification of species variety, extent, distribution, population sizes;	Treat as plan or project as appropriate, taking into account long term management requirements and predicted climatic impacts.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
<p>means of disposal of harbour dredgings. At Amroth recharge of shingle beach. See relevant shoreline management plan</p>	<p>toxic & non-toxic contaminants</p> <p><u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime</p>												<p>consequential near and far-field modification of species variety, extent, distribution, particularly sediment living species adjacent to wave exposed coastlines.</p> <p><u>Operation specific information required</u>: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</p>	
<p>Coast protection / defence (including beach replenishment) *#</p> <p>Widespread adjacent to coastal settlements See relevant shoreline management plan</p>	<p><u>Geophysical regime</u>: modification of substrate, hydrodynamic regime & sediment transport</p> <p><u>Fundamental environmental parameters</u>: suspended sediments, turbidity</p> <p><u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants</p> <p><u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime</p>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<p><u>Extent & distribution</u>: potential loss of / reduction in habitat extent.</p> <p><u>Structure & function</u>: 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</p> <p><u>Conservation status of typical species & species features</u>: 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.</p> <p><u>Operation specific information required</u>: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</p>	<p>Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).</p>
<p>Coastal protection: Barrages (amenity, storm surge, tidal) *#</p> <p>Historical proposal in Loughor Estuary. Local interest remains. Development interest feasible.</p>	<p><u>Geophysical regime</u>: modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure</p> <p><u>Fundamental environmental parameters</u>: modification of salinity, suspended sediments, turbidity, dissolved oxygen, temperature, seabed illuminance</p> <p><u>Environmental quality</u>: toxic & non-toxic contaminant build-up; modification of suspended particulates; organic enrichment</p> <p><u>Physical disturbance</u>: displacement</p>	✓	✓	✓	✓	✓	✓	✓			✓	✓	<p><u>Extent & distribution</u>: 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</p> <p><u>Structure & function</u>: 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</p> <p>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.</p> <p><u>Conservation status of typical species & species features</u>: decrease in species variety, modification of distribution; change in species composition from fully saline and mixed salinity to low salinity species. Consequential</p>	<p>Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).</p>

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
													<p>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)</p> <p><i>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.</i></p>	
<p>Foreshore deposit of rock, rubble etc.</p> <p><i>Anecdotal & opportunistic observations</i></p>	<p><u>Geophysical regime:</u> modification of substrate, hydrodynamic regime & sediment transport</p> <p><u>Fundamental environmental parameters:</u> suspended sediments, turbidity</p> <p><u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants</p> <p><u>Physical disturbance:</u> displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime</p>	✓	✓	✓	✓	✓					✓	✓	<p><u>Extent & distribution:</u> 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</p> <p><u>Structure & function:</u> 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</p> <p>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.</p> <p><u>Conservation status of typical species & species features:</u> 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)</p> <p><i>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.</i></p>	<p>Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).</p>

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Artificial reef <i>Development interest feasible.</i>	<u>Geophysical regime:</u> modification of tidal, streams, wave exposure, substrate, sediment transport <u>Fundamental environmental parameters:</u> modification of salinity, suspended sediments, turbidity, dissolved oxygen, temperature, seabed illuminance <u>Environmental quality:</u> modification of suspended particulates <u>Physical disturbance:</u> displacement, smothering,	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution:</u> loss of / reduction in habitat extent <u>Structure & function:</u> 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) <u>Conservation status of typical species & species features:</u> modification in species variety, distribution, composition, ranges <u>Operation specific information required:</u> <i>location, extent, scale of structure; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Hard-engineered freshwater watercourses *# <i>Presence mapped.</i>	<u>Geophysical regime:</u> substrate, sediment transport <u>Fundamental environmental parameters:</u> modification of salinity, suspended sediments, turbidity <u>Physical disturbance:</u> displacement	✓	✓	✓	✓	✓	✓	✓	✓			✓	<u>Structure & function:</u> localised, and potential far-field, modification of salinity regime and water circulation. <u>Conservation status of typical species & species features:</u> localised modification of species distribution, composition and variety. <u>Operation specific information required:</u> <i>location, extent, and scale of modification to discharge; timing and duration of construction; relevant location-specific biotic and abiotic information.</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Power station *# <i>Development interest feasible.</i>	<u>Fundamental environmental parameters:</u> thermal discharge; local modification of salinity <u>Environmental quality:</u> addition of toxic contaminants - biocides; atmospheric discharge; deposition of toxic & non-toxic contaminants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function:</u> localised, and potential far-field, modification of thermal regime; salinity and water circulation; possible increase in contaminants. <u>Conservation status of typical species & species features:</u> 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. <u>Operation specific information required:</u> <i>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.</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Pipelines *# <i>Gas pipeline beneath Loughor Estuary.</i>	<u>Geophysical regime:</u> addition of artificial substrate; local modification of water movement <u>Physical disturbance:</u> displacement, visual, noise; scour effect from cables due to wave action.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function:</u> dependent on depth of pipeline burial in seabed – modification of sediment transport processes and local hydrodynamic regime. <u>Conservation status of typical species & species features:</u> dependent on depth of pipeline burial in seabed – localised modification of species composition, variety. <u>Operation specific information required:</u> <i>location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
<p>Power / communication cables *#</p> <p><i>Development interest feasible. (Overhead cables at Loughor.)</i></p>	<p><u>Geophysical regime</u>: addition of artificial substrate; local modification of water movement</p> <p><u>Physical disturbance</u>: displacement, visual, noise. Potential electro-magnetic effects of electrical cables.</p>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<p><u>Structure & function</u>: dependent on depth of cable burial in seabed – modification of sediment transport processes and local hydrodynamic regime.</p> <p><u>Conservation status of typical species & species features</u>: dependent on depth of cable burial in seabed – localised modification of species composition, variety. Modification of behaviour caused by electro-magnetic effects.</p> <p><u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</p>	<p>Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).</p>
WASTE DISPOSAL														
<p>Effluent disposal; domestic & industrial (sewage & chemical)</p> <p><i>Widespread & common. NRW datasets of locations and inputs; NRW assessments: Historical changes in sewage treatment and disposal. Historical long-term increase; relatively recent decrease in solids and nutrients outputs, and changes in disposal points; recent short-term variations in discharge locations, volumes and treatment (reportedly more less-treated outputs via CSOs).</i></p>	<p><u>Geophysical regime</u>: modification of & addition to substrate</p> <p><u>Fundamental environmental parameters</u>: elevation of suspended particulates; oxygen depletion</p> <p><u>Environmental quality</u>: 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</p> <p><u>Physical disturbance</u>: smothering</p>	✓	✓	✓	✓	✓		✓	✓	✓		✓	<p><u>Structure & function</u>: 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.</p> <p><u>Conservation status of typical species & species features</u>: 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; <i>inter alia</i>:</p> <ul style="list-style-type: none"> - 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. 	<p>Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).</p>

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
													<i>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.</i>	
Effluent disposal: thermal* <i>None known</i>	<u>Fundamental environmental parameters:</u> thermal regime; possibly also salinity, suspended particulates; oxygen depletion	✓	✓	✓	✓	✓		✓	✓	✓		✓	<u>Structure & function:</u> local modification of thermal regime; possible modification of salinity regimes and water quality depending on content of discharge <u>Conservation status of typical species & species features:</u> 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. <i>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.</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Sludge dumping* <i>None at present</i>	<u>Geophysical regime:</u> modification of & addition to substrate <u>Fundamental environmental parameters:</u> elevation of suspended particulates; oxygen depletion <u>Environmental quality:</u> addition of nutrients; suspended; toxic & non-toxic contaminants; microbial pathogens; organic enrichment <u>Physical disturbance:</u> smothering	✓	✓	✓	✓	✓		✓	✓	✓		✓	<u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> effects on the 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. <i>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</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Miscellaneous wastes & debris (including refuse & litter) <i>Widespread & common incl. fly-tipping & illegal waste disposal: varies in scale from sporadic small-scale opportunistic fly-tipping to commercial fly-tipping, although generally confined to</i>	<u>Geophysical regime:</u> addition of persistent artificial substrates <u>Environmental quality:</u> Addition of toxic & non-toxic contaminants <u>Physical disturbance:</u> entanglement, smothering	✓	✓	✓	✓	✓		✓	✓	✓		✓	<u>Structure & function:</u> 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 <u>Conservation status of typical species & species features:</u> modification of species composition; population sizes; range and mobility. <i>Operation specific information required: location, extent, scale, frequency, timing, duration, nature and composition of disposal; relevant location-specific biotic and abiotic</i>	Enforce relevant legislation. Education & awareness raising

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
<i>specific locations.</i>														
Dredge spoil disposal * <i>Nearest dredge material disposal sites are in the outer Swansea Bay and SW of Milford Haven, used for disposal of maintenance dredgings from local harbours & ports. Local, small scale relocation used for beach replenishment at small Pembrokeshire harbours. Burry Port dredgings from navigation channel disposed adjacent to channel.</i>	<u>Geophysical regime:</u> modification of sediment transport processes; alteration to substrate <u>Fundamental environmental parameters:</u> changes to suspended sediments, turbidity; dissolved oxygen <u>Environmental quality:</u> increased nutrients; remobilisation of toxic & non-toxic contaminants <u>Physical disturbance:</u> smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	<u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> modification of species composition – shift toward more disturbance tolerant species; effects on population sizes, physiological health, reproduction, biomass. <u>Operation specific information required:</u> <i>location, extent, scale, frequency, timing, duration, nature and composition of spoil and nature and composition of contamination of</i>	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary). Develop and implement best practice appropriate for disposal sites
Urban & industrial run-off* <i>Widespread & common</i>	<u>Fundamental environmental parameters:</u> suspended particulates – increased turbidity; oxygen depletion <u>Environmental quality:</u> addition of toxic & non-toxic contaminants - petrochemicals, PAHs, PCBs, metals & organo-metals, organohalides, biocides, surfactants, hormone mimics, oxidising and reducing agents, and other organic & inorganic compounds.	✓	✓	✓	✓	✓		✓	✓	✓		✓	<u>Structure & function:</u> modification of water & sediment chemistry – nutrient enrichment; contaminant increases; potential local modification of suspended particulates. <u>Conservation status of typical species & species features:</u> 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, modification of species composition and biomass. <u>Operation specific information required:</u> <i>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</i>	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 information. Include in assessment of plans and projects as appropriate
Agricultural run-off	<u>Geophysical regime:</u> addition to substrate, modification to hydrodynamic regime & sediment transport <u>Fundamental environmental</u>	✓	✓	✓	✓	✓		✓	✓	✓		✓	<u>Structure & function:</u> modification of water & sediment chemistry – nutrient enrichment; contaminant increases; increase in suspended particulates/turbidity; decrease in light penetration through water column, increased oxygen demand.	Continued surveillance and monitoring of inputs and water quality by NRW; continued development and promotion of

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
<p><i>Widespread & common. Hypertrophication within estuaries.</i></p>	<p><u>parameters</u>: elevation of suspended sediments; oxygen depletion</p> <p><u>Environmental quality</u>: addition of toxic & non-toxic contaminants - nutrient & organic carbon enrichment, biocides (herbicides, pesticides, fungicides), surfactants.</p>												<p><u>Conservation status of typical species & species features</u>: 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.</p> <p><u>Operation specific information required</u>: location, extent, scale, frequency, timing, duration, composition of run-off; relevant location-specific biotic and abiotic information</p>	<p>good practice.</p>
EXPLOITATION OF LIVING RESOURCES														
<p>Trawling: beam</p> <p><i>Unknown</i></p>	<p><u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris</p> <p><u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates.</p> <p><u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise</p> <p><u>Other factors</u>: removal of target species</p>	✓	✓			✓	✓	✓	✓	✓	✓	✓	<p><u>Structure & function</u>: 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).</p> <p><u>Conservation status of typical species & species features</u>: 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.</p> <p><u>Operation specific information required</u>: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	<p>To secure features at FCS, assess the impacts from the activity on the features of the site.</p>
<p>Trawling: otter</p> <p><i>Occurs throughout site, location and effort information is unknown.</i></p>	<p><u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris</p> <p><u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates.</p> <p><u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise</p> <p><u>Other factors</u>: removal of target species</p>	✓	✓			✓	✓	✓	✓	✓	✓	✓	<p><u>Structure & function</u>: 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).</p> <p><u>Conservation status of typical species & species features</u>: 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.</p> <p><u>Operation specific information required</u>: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	<p>To secure features at FCS, assess the impacts from the activity on the features of the site</p>

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Dredging: toothed <i>Does not occur</i>	<u>Geophysical regime:</u> modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters:</u> elevation of turbidity & suspended particulates. <u>Physical disturbance:</u> displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors:</u> removal of target species	✓	✓			✓	✓				✓		<u>Structure & function:</u> 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). <u>Conservation status of typical species & species features:</u> 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. <u>Operation specific information required:</u> gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information	This activity has been assessed and is not permitted within the site.
Dredging: bladed – mussel <i>Local, minor, occasional (Burry Port channel).</i>	<u>Geophysical regime:</u> modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters:</u> elevation of turbidity & suspended particulates. <u>Physical disturbance:</u> displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors:</u> removal of target species	✓	✓			✓	✓				✓	✓	<u>Structure & function:</u> 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). <u>Conservation status of typical species & species features:</u> 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. <u>Operation specific information required:</u> gear type and size; 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.
Dredging: bladed – mussel seed <i>Intermittently at a few localised areas.</i>	<u>Geophysical regime:</u> modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters:</u> elevation of turbidity & suspended particulates. <u>Physical disturbance:</u> displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors:</u> removal of target species	✓	✓			✓	✓				✓	✓	<u>Structure & function:</u> 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). <u>Conservation status of typical species & species features:</u> 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	This is a permitted fishery and undergoes Habitat Regulation Assessments.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
													species feature behaviours and consequential effects. <i>Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	
Dredging: bladed - oyster <i>Not known to occur.</i>	<u>Geophysical regime:</u> modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters:</u> elevation of turbidity & suspended particulates. <u>Physical disturbance:</u> displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors:</u> removal of target species	✓	✓			✓	✓				✓		<u>Structure & function:</u> 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). <u>Conservation status of typical species & species features:</u> 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. <i>Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.
Dredging : mechanical – cockle <i>Not an approved Welsh Government fishing method.</i>	<u>Geophysical regime:</u> modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters:</u> elevation of turbidity & suspended particulates. <u>Physical disturbance:</u> displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors:</u> removal of target species	✓	✓			✓					✓		<u>Structure & function:</u> 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). <u>Conservation status of typical species & species features:</u> 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. <i>Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.
Dredging: deep hydraulic (e.g. WJID) <i>Some Interest exists.</i>	<u>Geophysical regime:</u> modification of substrate <u>Fundamental environmental parameters:</u> elevation of turbidity & suspended particulates <u>Environmental quality:</u> remobilisation of	✓	✓			✓	✓				✓		<u>Structure & function:</u> 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)	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
	<p>toxic & non-toxic contaminants</p> <p><u>Physical disturbance</u>: displacement, crushing, amputation, smothering</p> <p><u>Other factors</u>: removal of target species</p>												<p><u>Conservation status of typical species & species features</u>: 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.</p> <p><u>Operation specific information required</u>: gear type and size; target species; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.</p>	
<p>Dredging: shallow hydraulic (e.g. suction)</p> <p><i>Not an approved Welsh Government fishing method.</i></p>	<p><u>Geophysical regime</u>: modification of substrate</p> <p><u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates</p> <p><u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants</p> <p><u>Physical disturbance</u>: displacement, crushing, amputation, smothering</p> <p><u>Other factors</u>: removal of target species</p>	✓	✓			✓	✓				✓		<p><u>Structure & function</u>: 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</p> <p><u>Conservation status of typical species & species features</u>: 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)</p> <p><u>Operation specific information required</u>: gear type; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	<p>This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.</p>
<p>Netting: (bottom set gill)</p> <p><i>Occurs extensively throughout Bay but location and effort information is unknown.</i></p>	<p><u>Geophysical regime</u>: modification of substrate -addition of persistent inert debris</p> <p><u>Physical disturbance</u>: entanglement, displacement (target & non-target species), amputation, abrasion</p> <p><u>Other factors</u>: removal of target species</p>	✓	✓			✓	✓	✓	✓	✓	✓		<p><u>Structure & function</u>: 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.</p> <p><u>Conservation status of typical species & species features</u>: 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.</p> <p><u>Operation specific information required</u>: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	<p>To secure features at FCS, assess the impacts from the activity on the features of the site.</p>

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
<p>Netting: bottom-set tangle / trammel</p> <p><i>Occurs extensively throughout Bay but location and effort information is unknown.</i></p>	<p><u>Geophysical regime:</u> modification of substrate -addition of persistent inert debris</p> <p><u>Physical disturbance:</u> entanglement, displacement (target & non-target species), amputation, abrasion</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓			✓	✓	✓	✓	✓	✓		<p><u>Structure & function:</u> 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.</p> <p><u>Conservation status of typical species & species features:</u> 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.</p> <p><u>Operation specific information required:</u> gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	To secure features at FCS, assess the impacts from the activity on the features of the site.
<p>Netting: surface-set gill</p> <p><i>Occurs extensively throughout Bay but location and effort information is unknown.</i></p>	<p><u>Geophysical regime:</u> modification of substrate -addition of persistent inert debris</p> <p><u>Physical disturbance:</u> entanglement, displacement (target & non-target species), amputation, abrasion</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓			✓	✓	✓	✓	✓	✓		<p><u>Structure & function:</u> 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.</p> <p><u>Conservation status of typical species & species features:</u> 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.</p> <p><u>Operation specific information required:</u> gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	To secure features at FCS, assess the impacts from the activity on the features of the site.
<p>Netting: beach seine</p> <p><i>Occurs on open beaches, Three Rivers confluence and Burry Inlet; but intensity and effort information is unknown.</i></p>	<p><u>Geophysical regime:</u> modification of substrate -addition of persistent inert debris</p> <p><u>Physical disturbance:</u> entanglement, displacement (target & non-target species), amputation, abrasion</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓			✓	✓	✓	✓	✓			<p><u>Structure & function:</u> 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.</p> <p><u>Conservation status of typical species & species features:</u> 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.</p> <p><u>Operation specific information required:</u> gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
<p>Netting: demersal seine</p> <p>Not known to occur.</p>	<p><u>Geophysical regime:</u> modification of substrate -addition of persistent inert debris</p> <p><u>Physical disturbance:</u> entanglement, displacement (target & non-target species), amputation, abrasion</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓			✓	✓	✓	✓	✓	✓		<p><u>Structure & function:</u> 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.</p> <p><u>Conservation status of typical species & species features:</u> 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.</p> <p><u>Operation specific information required:</u> gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	To secure features at FCS, assess the impacts from the activity on the features of the site.
<p>Netting: beach-set gill</p> <p>Occurs on open beaches, Three Rivers confluence and Burry Inlet; but intensity and effort information is unknown.</p>	<p><u>Geophysical regime:</u> modification of substrate -addition of persistent inert debris</p> <p><u>Physical disturbance:</u> entanglement, displacement (target & non-target species), amputation, abrasion</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓			✓	✓	✓	✓	✓	✓	✓	<p><u>Structure & function:</u> 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.</p> <p><u>Conservation status of typical species & species features:</u> 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.</p> <p><u>Operation specific information required:</u> gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	To secure features at FCS, assess the impacts from the activity on the features of the site.
<p>Netting: other (e.g. fyke)</p> <p>Not know to occur?</p>	<p><u>Geophysical regime:</u> modification of substrate -addition of persistent inert debris</p> <p><u>Physical disturbance:</u> entanglement, displacement (target & non-target species), amputation, abrasion</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓			✓	✓	✓	✓	✓	✓	✓	<p><u>Structure & function:</u> 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.</p> <p><u>Conservation status of typical species & species features:</u> 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.</p> <p><u>Operation specific information required:</u> gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Potting: lobster / crab <i>Mainly confined to SW Gower coast and deep rocky areas in Bay but intensity and effort information is unknown.</i>	<u>Geophysical regime:</u> modification of substrate -addition of persistent inert debris <u>Physical disturbance:</u> displacement, crushing & abrasion <u>Other factors:</u> removal of target species	✓	✓				✓						<u>Structure & function:</u> modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), potential reduction of prey availability for predators (including species features) <u>Conservation status of typical species & species features:</u> 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. <u>Operation specific information required:</u> 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: prawn <i>Not known to occur.</i>	<u>Geophysical regime:</u> modification of substrate - addition of persistent inert debris <u>Physical disturbance:</u> displacement, crushing & abrasion <u>Other factors:</u> removal of target species	✓	✓			✓	✓						<u>Structure & function:</u> modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), potential reduction of prey availability for predators (including species features) <u>Conservation status of typical species & species features:</u> 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. <u>Operation specific information required:</u> 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: whelk <i>Occurs extensively throughout site but intensity, location and effort information is unknown.</i>	<u>Geophysical regime:</u> modification of substrate -addition of persistent inert debris <u>Physical disturbance:</u> displacement, crushing & abrasion <u>Other factors:</u> removal of target species	✓	✓			✓	✓						<u>Structure & function:</u> modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), potential reduction of prey availability for predators (including species features) <u>Conservation status of typical species & species features:</u> 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. <u>Operation specific information required:</u> 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	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Line: long-line <i>Occurs mainly in NE quadrant of Bay / off estuary entrances; mainly seasonal (targeting bass), intensity and effort information is unknown.</i>	<u>Physical disturbance:</u> displacement <u>Other factors:</u> removal of target species	✓	✓			✓	✓	✓	✓	✓			<u>Structure & function:</u> potential reduction of prey availability for predators (including species features) <u>Conservation status of typical species & species features:</u> depletion of target & non-target species populations and modification of population structures. <u>Operation specific information required:</u> 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.
Line: handline <i>Limited, mainly NE quadrant of Bay intensity and effort information is unknown.</i>	<u>Physical disturbance:</u> displacement <u>Other factors:</u> removal of target species	✓	✓			✓	✓	✓	✓				<u>Structure & function:</u> potential reduction of prey availability for predators (including species features) <u>Conservation status of typical species & species features:</u> depletion of target & non-target species populations and modification of population structures. <u>Operation specific information required:</u> 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.
Electro-fishing: molluscs <i>Not approved Welsh Government fishing method.</i>	<u>Other factors:</u> removal of target species, possible impact to non-target species.	✓	✓			✓	✓	✓	✓		✓		<u>Conservation status of typical species & species features:</u> 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.	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.
Hand gathering: cockles (excluding access issues) <i>Major commercial fisheries. Some casual private collection.</i>	<u>Geophysical regime:</u> modification of substrate, physical structure <u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen <u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance:</u> displacement, possible crushing & amputation, visual <u>Other factors:</u> removal of target species	✓	✓			✓					✓		<u>Structure & function:</u> 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 <u>Conservation status of typical species & species features:</u> 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 <u>Operation specific information required:</u> target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic	Commercial: This is a permitted fishery and has to undergo a Habitats Regulation Assessment. Casual: To secure features at FCS, assess the impacts from the activity on the features of the site.
Hand gathering: mussels	<u>Geophysical regime:</u> modification of substrate, physical structure	✓	✓			✓						✓	<u>Structure & function:</u> modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of	Commercial: This is a permitted fishery and has to undergo a Habitats Regulation

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
<p>(excluding access issues)</p> <p><i>Major commercial fisheries.</i></p> <p><i>Some casual private collection</i></p>	<p><u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen</p> <p><u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging)</p> <p><u>Physical disturbance:</u> displacement, possible crushing & amputation, visual</p> <p><u>Other factors:</u> removal of target species</p>												<p>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</p> <p><u>Conservation status of typical species & species features:</u> 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</p> <p><u>Operation specific information required:</u> target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic</p>	<p>Assessment.</p> <p>Casual: To secure features at FCS, assess the impacts from the activity on the features of the site.</p>
<p>Hand gathering: mussel seed (excluding access issues)</p> <p><i>Major commercial fisheries.</i></p> <p><i>Some casual private collection.</i></p>	<p><u>Geophysical regime:</u> modification of substrate, physical structure</p> <p><u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen</p> <p><u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging)</p> <p><u>Physical disturbance:</u> displacement, possible crushing & amputation, visual</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓			✓						✓	<p><u>Structure & function:</u> 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</p> <p><u>Conservation status of typical species & species features:</u> 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</p> <p><u>Operation specific information required:</u> target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic</p>	<p>This is a permitted fishery and has to undergo a Habitats Regulation Assessment.</p>
<p>Hand gathering: razor clam (including salting)</p> <p><i>Occurs Saundersfoot & Rhossili.</i></p> <p><i>Intensity and effort information is unknown.</i></p>	<p><u>Geophysical regime:</u> modification of substrate, physical structure</p> <p><u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen</p> <p><u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging)</p> <p><u>Physical disturbance:</u> displacement, possible crushing & amputation, visual</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓			✓		✓				✓	<p><u>Structure & function:</u> 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</p> <p><u>Conservation status of typical species & species features:</u> 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</p> <p><u>Operation specific information required:</u> target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic</p>	<p>To secure features at FCS, assess the impacts from the activity on the features of the site.</p>
<p>Hand gathering: other bivalves</p>	<p><u>Geophysical regime:</u> modification of substrate, physical structure</p> <p><u>Fundamental environmental</u></p>	✓	✓			✓							<p><u>Structure & function:</u> 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)</p>	<p>To secure features at FCS, assess the impacts from the activity on the features of the</p>

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Some Gathering various long-live, slow growing bivalve species (e.g. Mya, Lutraria) reported from Tenby / Saundersfoot & Rhosilli; intensity and effort information is unknown.	<p><u>parameters</u>: elevation of turbidity; reduced oxygen</p> <p><u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging)</p> <p><u>Physical disturbance</u>: displacement, possible crushing & amputation, visual</p> <p><u>Other factors</u>: removal of target species</p>												<p>through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species</p> <p><u>Conservation status of typical species & species features</u>: 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</p> <p><u>Operation specific information required</u>: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic</p>	site.
<p>Hand gathering: winkles</p> <p>Occurs at Gower & Tenby / Saundersfoot, intensity and effort information is unknown.</p>	<p><u>Geophysical regime</u>: modification of substrate, physical structure</p> <p><u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen</p> <p><u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging)</p> <p><u>Physical disturbance</u>: displacement, possible crushing & amputation, visual</p> <p><u>Other factors</u>: removal of target species</p>	✓	✓										<p><u>Structure & function</u>: 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</p> <p><u>Conservation status of typical species & species features</u>: 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</p> <p><u>Operation specific information required</u>: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic</p>	To secure features at FCS, assess the impacts from the activity on the features of the site.
<p>Hand gathering: crustacean / shellfish</p> <p>No information.</p>	<p><u>Geophysical regime</u>: modification of substrate, physical structure</p> <p><u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen</p> <p><u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging)</p> <p><u>Physical disturbance</u>: displacement, possible crushing & amputation, visual</p> <p><u>Other factors</u>: removal of target species</p>	✓	✓						✓	✓	✓		<p><u>Structure & function</u>: 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</p> <p><u>Conservation status of typical species & species features</u>: 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</p> <p><u>Operation specific information required</u>: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic</p>	To secure features at FCS, assess the impacts from the activity on the features of the site.
<p>Hand gathering: algae & plants</p>	<p><u>Geophysical regime</u>: modification of substrate, physical structure</p>		✓	✓	✓	✓						✓	<p><u>Structure & function</u>: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of</p>	To secure features at FCS, assess the impacts from the activity on the features of the

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
for human consumption (e.g. Porphyra, Salicornia) <i>Occurs Burry Inlet, intensity and effort information is unknown</i>	<u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen <u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance:</u> displacement, possible crushing & amputation, visual <u>Other factors:</u> removal of target species												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 <u>Conservation status of typical species & species features:</u> 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 <u>Operation specific information required:</u> target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic	site.
Hand gathering: access and vehicle use	<u>Geophysical regime:</u> modification of substrate, physical structure <u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen <u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance:</u> displacement, possible crushing & amputation, visual <u>Other factors:</u> removal of target species	✓	✓	✓	✓	✓						✓	<u>Structure & function:</u> 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 <u>Conservation status of typical species & species features:</u> 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 <u>Operation specific information required:</u> target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic	This is a permitted activity and has to undergo a Habitats Regulation Assessment.
Hand / mechanical gathering: algae for chemical extraction / biomass <i>No information.</i>	<u>Geophysical regime:</u> modification of substrate, physical structure <u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen <u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance:</u> displacement, possible crushing & amputation, visual <u>Other factors:</u> removal of target species	✓	✓			✓						✓	<u>Structure & function:</u> 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 <u>Conservation status of typical species & species features:</u> 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 <u>Operation specific information required:</u> target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic	To secure features at FCS, assess the impacts from the activity on the features of the site.
Bait collection: digging	<u>Geophysical regime:</u> modification of substrate physical structure (direct and indirect through addition of artificial habitat to attract bait species, e.g. 'crab	✓	✓		✓	✓						✓	<u>Structure & function:</u> 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)	To secure features at FCS, assess the impacts from the activity on the features of the

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action	
Occurs throughout site, location and effort information is unknown.	<p>tiles')</p> <p><u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen, local salinity modification ('salting')</p> <p><u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging)</p> <p><u>Physical disturbance:</u> displacement; possible crushing, amputation & smothering</p> <p><u>Other factors:</u> removal of target species</p>												<p>through depletion of target species (including ecologically structuring species); modification of prey and food availability for predator and scavenger species</p> <p><u>Conservation status of typical species & species features:</u> 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</p> <p><u>Operation specific information required:</u> target species and shore type; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information</p>	<p>site.</p> <p>Education & awareness raising</p>	
<p>Bait collection: pump</p> <p>Usually occurs in open beaches e.g. Rhosilli (Main target: Black lug).</p>	<p><u>Geophysical regime:</u> modification of substrate physical structure</p> <p><u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen, local salinity modification ('salting')</p> <p><u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging)</p> <p><u>Physical disturbance:</u> displacement; possible crushing, amputation & smothering</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓		✓	✓						✓	<p><u>Structure & function:</u> 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</p> <p><u>Conservation status of typical species & species features:</u> 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</p> <p><u>Operation specific information required:</u> target species and shore type; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information</p>	<p>To secure features at FCS, assess the impacts from the activity on the features of the site.</p> <p>Education & awareness raising</p>	
<p>Bait collection: boulder turning</p> <p>Occurs throughout site, location and effort information is unknown.</p>	<p><u>Geophysical regime:</u> modification of substrate physical structure</p> <p><u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen, local salinity modification ('salting')</p> <p><u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants (digging)</p> <p><u>Physical disturbance:</u> displacement; possible crushing, amputation & smothering</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓										✓	<p><u>Structure & function:</u> modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (eg 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</p> <p><u>Conservation status of typical species & species features:</u> depletion of target species populations and modification of population structures; modification of non-target species composition and variety (eg increase in predatory species) in sediment habitats; potential depletion of vertebrate predator prey species</p> <p><u>Operation specific information required:</u> target species and shore type; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information</p>	<p>To secure features at FCS, assess the impacts from the activity on the features of the site.</p> <p>Education & awareness raising</p>

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Collection, for aquarium / curio trade <i>Occurs throughout site, location and effort information is unknown.</i>	<u>Physical disturbance:</u> displacement, amputation, visual <u>Other factors:</u> removal of target species	✓	✓	✓	✓	✓	✓						<u>Structure & function:</u> modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species <u>Conservation status of typical species & species features:</u> depletion of target species populations and modification of target & non-target species population structures. <u>Operation specific information required:</u> 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.
Grazing of saltmarsh <i>Significant. Stocking level information not acquired. Stock management variable.</i>	<u>Geophysical regime:</u> modification of substrate physical structure <u>Fundamental environmental parameters:</u> elevation of turbidity; reduced oxygen, local salinity modification ('salting') <u>Environmental quality:</u> remobilisation of toxic & non-toxic contaminants <u>Physical disturbance:</u> displacement; possible crushing, amputation & smothering <u>Other factors:</u> removal of target species	✓	✓	✓	✓	✓							<u>Structure & function:</u> disturbance or modification of habitat structure by grazing animals <u>Conservation status of typical species & species features:</u> modification of target species population size and structures <u>Operation specific information required:</u> 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: algae <i>Not known to occur.</i>	<u>Geophysical regime:</u> modification of substrate structure, sedimentology, sediment transport <u>Fundamental environmental parameters:</u> oxygen depletion <u>Environmental quality:</u> organic enrichment <u>Physical disturbance:</u> displacement, smothering <u>Other factors:</u> introduction of non-native species	✓	✓			✓							<u>Structure & function:</u> modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (nutrients, contaminants, sediment oxygen depletion); modification of biological interactions (e.g. predator-prey relationships) <u>Conservation status of typical species:</u> 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 <u>Operation specific information required:</u> 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 - sea cages or impoundments* <i>Not known to occur.</i>	<u>Fundamental environmental parameters:</u> oxygen depletion <u>Environmental quality:</u> toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants	✓	✓			✓		✓	✓	✓			<u>Extent & distribution:</u> potential decrease in (intertidal) habitat extent <u>Structure & function:</u> modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) <u>Conservation status of typical species & species features:</u> local modification of species physiological health, variety, composition within	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
	<u>Other factors:</u> introduction of non-native species												zone of influence; modification of behaviour and range of predatory species (including species features) <i>Operation specific information required: location, extent and scale; species and aquaculture practices; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</i>	
Aquaculture: crustaceans - sea cages or impoundments * <i>Not known to occur.</i>	<u>Fundamental environmental parameters:</u> oxygen depletion <u>Environmental quality:</u> toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants <u>Other factors:</u> introduction of non-native species	✓	✓							✓			<u>Extent & distribution:</u> potential decrease in (intertidal) habitat extent <u>Structure & function:</u> modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) <u>Conservation status of typical species & species features:</u> local modification of species physiological health, variety, composition within zone of influence; modification of behaviour and range of predatory species (including species features) <i>Operation specific information required: location, extent and scale; species and aquaculture practices; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</i>	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.
Aquaculture: molluscan 'ranching' * <i>No known Several orders in site</i>	<u>Fundamental environmental parameters:</u> oxygen depletion <u>Environmental quality:</u> toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants <u>Other factors:</u> introduction of non-native species	✓	✓			✓							<u>Extent & distribution:</u> potential decrease in (intertidal) habitat extent <u>Structure & function:</u> modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) <u>Conservation status of typical species & species features:</u> local modification of species physiological health, variety, composition within zone of influence; modification of behaviour and range of predatory species (including species features) <i>Operation specific information required: location, extent and scale; species and aquaculture practices; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</i>	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) <i>Not known to occur.</i>	<u>Fundamental environmental parameters:</u> oxygen depletion <u>Environmental quality:</u> nutrient & organic enrichment; possible addition of pesticides & antifoulants <u>Other factors:</u> introduction of non-native species	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	<u>Structure & function:</u> 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) <u>Conservation status of typical species & species features:</u> 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) <i>Operation specific information required: species and aquaculture structures; location, extent, scale and duration; relevant location-specific biotic and abiotic information</i>	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Aquaculture: land based semi-enclosed / recirculation * <i>Interest expressed. Ragworm farm operational at Pendine.</i>	<u>Fundamental environmental parameters:</u> oxygen availability; turbidity <u>Environmental quality:</u> nutrient & organic enrichment; biocides, antibiotics	✓	✓	✓	✓	✓		✓	✓	✓			<u>Structure & function:</u> modification of water chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) <u>Conservation status of typical species & species features:</u> local modification of species physiological health, variety, composition within zone of influence <u>Operation specific information required:</u> 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* <i>Abstraction from freshwater inputs site-wide.</i>	<u>Geophysical regime:</u> modification of flow regime <u>Fundamental environmental parameters:</u> salinity	✓	✓	✓	✓	✓		✓	✓	✓			<u>Structure & function:</u> local modification of hydrography, temperature, water chemistry & salinity regime <u>Conservation status of typical species & species features:</u> modification of species variety and composition within zone of influence <u>Operation specific information required:</u> 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)	<u>Geophysical regime:</u> removal and alteration of substrate; modification of sediment transport, wave and tidal stream regimes <u>Fundamental Environmental Parameters:</u> elevation of turbidity / suspended particulates <u>Physical disturbance:</u> displacement, smothering <u>Other factors:</u> removal of biota;	✓	✓			✓	✓	✓	✓				<u>Extent & distribution:</u> potential decrease in size of sandbanks and modification in extent of sediment features <u>Structure & function:</u> modification of habitat structure, sedimentology, morphology, sediment transport processes, hydrodynamics <u>Conservation status of typical species & species features:</u> modification of species composition and variety, including decline in species adapted to sandbank habitat conditions; effects on population sizes, physiological health, reproduction, and biomass. <u>Operation specific information required:</u> 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* <i>Unlikely to be pursued.</i>	<u>Physical disturbance:</u> noise (dependant on proximity to site)							✓	✓				<u>Extent & distribution:</u> potential decrease in size of sandbanks and modification in extent of sediment features <u>Structure & function:</u> modification of habitat structure, sedimentology, morphology, sediment transport processes, hydrodynamics <u>Conservation status of typical species & species features:</u> modification of species composition and variety, including decline in species adapted to sandbank habitat conditions; effects on population sizes, physiological health, reproduction, and biomass. <u>Operation specific information required:</u> target aggregate & method of extraction; location, extent, volume, frequency, timing and duration; relevant location-specific biotic and abiotic information	Treat new proposed developments as plan or project as appropriate.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
Oil & gas exploration & production: drilling operations* <i>Unlikely to be pursued.</i>	<u>Geophysical regime:</u> substrate modification <u>Environmental quality:</u> hydrocarbon contamination <u>Physical disturbance:</u> displacement, crushing, smothering in immediate vicinity; noise	✓						✓	✓	✓			<u>Conservation status of typical species & species features:</u> sub-lethal physiological effects & modification of behaviour of vertebrate species (including species features) <u>Operation specific information required:</u> 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: operational* & accidental discharges <i>Unlikely to be pursued.</i>	<u>Geophysical regime:</u> modification of substrate <u>Environmental quality:</u> petrochemicals, toxic contamination <u>Physical disturbance:</u> general physical effects	✓						✓	✓				<u>Structure & function:</u> water & sediment chemistry: elevation of contaminants (particularly hydrocarbons) and nutrient concentrations. <u>Conservation status of typical species & species features:</u> effects on species variety, composition, population dynamics & physiological health in species sensitive to hydrocarbons, organo-metal compounds, biocides, bleaches etc.; nutrient enrichment. <u>Operation specific information required:</u> 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.
Renewal energy generation: tidal barrage*# <i>Historical proposal in Loughor Estuary. Local interest remains.</i>	<u>Geophysical regime:</u> modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure <u>Fundamental environmental parameters:</u> salinity, suspended particulates, turbidity, dissolved oxygen, temperature, seabed light <u>Environmental quality:</u> toxic & non-toxic contaminant accumulation; organic enrichment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution:</u> 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 <u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> 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) <u>Operation specific information required:</u> location, extent, scale of	Treat as plan or project as appropriate.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
													<i>impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance</i>	
Renewable energy generation: tidal impoundment*# <i>Development interest feasible.</i>	<u>Geophysical regime:</u> modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure <u>Fundamental environmental parameters:</u> salinity, suspended particulates, turbidity, dissolved oxygen, temperature, seabed light <u>Environmental quality:</u> toxic & non-toxic contaminant accumulation; organic enrichment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution:</u> 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 <u>Structure & function:</u> 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. <u>Conservation status of typical species & species features:</u> 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) <u>Operation specific information required:</u> <i>location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance</i>	Treat as plan or project as appropriate.
Alternative energy production: tidal current turbine*# <i>Low possibility of development interest; low site suitability.</i>	<u>Geophysical regime:</u> modification of wave and tidal regimes; removal & alteration of substrate <u>Environmental quality:</u> possible toxic & non-toxic contaminants; modification of suspended particulates <u>Physical disturbance:</u> displacement, crushing, smothering by structures or anchoring mechanisms; collision; noise	✓	✓			✓	✓	✓	✓	✓	✓		<u>Extent & distribution:</u> potential habitat loss within footprint of generating structures <u>Structure & function:</u> potentially highly variable dependent on nature, construction and scale of structures. Modification of habitat structure, sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features:</u> modification of species variety, distribution, physiological health (collision, entrainment); modification of species ranges (disturbance; artificial reef effects) <u>Operation specific information required:</u> <i>type, construction & size; location & extent; timing and duration of installation; permanence; anchoring structures; cabling requirements; maintenance requirements & frequency; relevant location-specific biotic and abiotic information</i>	Treat as plan or project as appropriate.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Alternative energy production: coastal wave & tidal current *# <i>Low possibility of development interest; low site suitability.</i>	<u>Geophysical regime:</u> modification of wave and tidal regimes; removal & alteration of substrate <u>Environmental quality:</u> possible toxic & non-toxic contaminants; modification of suspended particulates <u>Physical disturbance:</u> displacement, crushing, smothering by structures or anchoring mechanisms; collision; noise	✓	✓				✓	✓	✓				<u>Extent & distribution:</u> potential habitat loss within footprint of generating structures <u>Structure & function:</u> potentially highly variable dependent on nature, construction and scale of structures. Modification of habitat structure, sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features:</u> modification of species variety, distribution, physiological health (collision, entrainment); modification of species ranges (disturbance; artificial reef effects) <u>Operation specific information required:</u> type, construction & size; location & extent; timing and duration of installation; permanence; anchoring structures; cabling requirements; maintenance requirements & frequency; relevant location-specific biotic and abiotic information	Treat as plan or project as appropriate.
Alternative energy generation: offshore wind *# <i>Development interest feasible.</i>	<u>Geophysical regime:</u> modification of wave and tidal regimes; modification to substrate <u>Environmental quality:</u> possible toxic & non-toxic contaminants <u>Physical disturbance:</u> general physical effects; possible collision	✓	✓				✓	✓			✓	✓	<u>Extent & distribution:</u> potential habitat loss within footprint of generating structures <u>Structure & function:</u> potentially highly variable dependent on nature, construction and scale of structures. Modification of sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features:</u> modification of species variety, & distribution; modification of species ranges (disturbance; artificial reef effects) <u>Operation specific information required:</u> 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 <i>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill).</i>	<u>Environmental quality:</u> toxic contamination - petrochemicals, surfactants, demulsifiers <u>Physical disturbance:</u> noise, visual	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function:</u> modification of water chemistry (with purpose of ameliorating degree of modification) <u>Conservation status of typical species & species features:</u> 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) <u>Operation specific information required:</u> 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 appropriate pollution response advice contingency plan
Oil spill response: shore cleaning – washing	<u>Geophysical regime:</u> modification & removal of substrate <u>Fundamental environmental parameters:</u> salinity; temperature	✓	✓	✓	✓	✓		✓	✓	✓		✓	<u>Structure & function:</u> local modification of habitat structure, salinity, thermal regime; water & sediment chemistry (remobilisation and/or sediment entrapment of hydrocarbon contaminants); <u>Conservation status of typical species & species features:</u> acute local depletion of population sizes, effects on physiological health and potential	Develop and maintain appropriate pollution response contingency plans; inclusion and maintenance of information on site features

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
<i>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill).</i>	<u>Environmental quality</u> : toxic contamination - petrochemicals <u>Physical disturbance</u> : displacement, crushing, abrasion, noise, visual												consequential population dynamics and distribution effects. Disturbance of vertebrate species, including species features <i>Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information</i>	and sensitivity to at-sea response activities in appropriate pollution response advice contingency plan
Oil spill response: shore cleaning - chemical <i>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill).</i>	<u>Environmental quality</u> : addition / increase petrochemicals, surfactants, demulsifiers <u>Physical disturbance</u> : including displacement	✓	✓	✓	✓	✓		✓	✓	✓		✓	<u>Structure & function</u> : modification of water & sediment chemistry; modification of biological interactions through changes in abundance and contamination of food resources <u>Conservation status of typical species & species features</u> : acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics <i>Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information</i>	Develop and maintain appropriate pollution response contingency plans; inclusion and maintenance of information on site features and sensitivity to at-sea response activities in appropriate pollution response advice contingency plan
Oil spill response: shore cleaning - physical <i>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill).</i>	<u>Geophysical regime</u> : modification & removal of substrate <u>Environmental quality</u> : toxic contamination - petrochemicals <u>Physical disturbance</u> : displacement, crushing, abrasion, trampling, noise, visual	✓	✓	✓	✓	✓				✓		✓	<u>Structure & function</u> : modification of habitat structure, sedimentology, water & sediment chemistry through remobilisation and transfer of hydrocarbon contamination <u>Conservation status of typical species & species features</u> : acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics <i>Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Develop and maintain appropriate pollution response contingency plans; inclusion and maintenance of information on site features and sensitivity to at-sea response activities in appropriate pollution response advice contingency plan
Oil spill response: shore cleaning - ancillary activities (access creation, vehicular impacts, wildlife rescue) <i>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill).</i>	<u>Geophysical regime</u> : modification of substrate <u>Environmental quality</u> : toxic contamination - petrochemicals <u>Physical disturbance</u> : displacement, crushing, abrasion, smothering, collision, noise, visual <u>Other factors</u> : removal of biota	✓	✓	✓	✓	✓	✓			✓		✓	<u>Structure & function</u> : modification of habitat structure, sedimentology <u>Conservation status of typical species & species features</u> : acute local modification of species population sizes, structures, physiological health; disturbance and displacement of vertebrate species including species features <i>Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Develop and maintain appropriate pollution response contingency plans; inclusion and maintenance of information on site features and sensitivity to at-sea response activities in appropriate pollution response advice contingency plan Treat as plan or project as appropriate.

RECREATION

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
Angling <i>Occurs extensively throughout the site but location and effort information is unknown.</i>	<u>Environmental quality</u> : metals, persistent inert debris <u>Physical disturbance</u> : displacement, entanglement <u>Other factors</u> : removal of target species	✓	✓				✓	✓	✓			✓	<u>Structure & function</u> : 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) <u>Conservation status of typical species & species features</u> : 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 <u>Operation specific information required</u> : 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 <i>Widespread and common</i>	<u>Geophysical regime</u> : modification of substrate physical structure <u>Physical disturbance</u> : displacement, possible crushing & amputation, visual <u>Other factors</u> : removal of target species;	✓	✓			✓				✓		✓	<u>Structure & function</u> : 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 <u>Conservation status of typical species & species features</u> : 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. <u>Operation specific information required</u> : 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.
Bait collection: digging & other sediment shore collection techniques* <i>Common, widespread with "hotspots" of activity.</i>	<u>Geophysical regime</u> : modification of substrate physical structure; sediment transport <u>Fundamental environmental parameters</u> : turbidity; oxygen; salinity <u>Environmental quality</u> : remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u> : displacement; possible crushing, amputation, smothering, visual <u>Other factors</u> : removal of target species	✓	✓		✓	✓				✓		✓	<u>Structure & function</u> : 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 <u>Conservation status of typical species & species features</u> : 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. <u>Operation specific information required</u> : 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	<u>Geophysical regime</u> : modification of substrate physical structure; wave	✓	✓	✓	✓	✓				✓	✓	✓	<u>Structure & function</u> : local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local	Education & awareness raising

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
speed power craft (incl. PWC) <i>Unquantified; localised, mainly in vicinity of Tenby, Saundersfoot and Burry Port. PWC use off Burry Port & in entrance to Burry Inlet; also western Bay.</i>	exposure regime <u>Fundamental environmental parameters:</u> turbidity <u>Environmental quality:</u> hydrocarbon contaminants; organic enrichment <u>Physical disturbance:</u> displacement, collision, noise, visual												modification of water quality (hydrocarbon and other contaminants) <u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; local modification of species composition <u>Operation specific information required:</u> location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information	Activity surveillance.
Recreational boating: low speed power craft <i>Unquantified; localised, mainly in vicinity of Tenby, Saundersfoot and Burry Port.</i>	<u>Geophysical regime:</u> modification of substrate physical structure; wave exposure regime <u>Fundamental environmental parameters:</u> turbidity <u>Environmental quality:</u> hydrocarbon contaminants; organic enrichment <u>Physical disturbance:</u> displacement, collision, noise, visual									✓	✓	✓	<u>Structure & function:</u> local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local modification of water quality (hydrocarbon and other contaminants) <u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; local modification of species composition <u>Operation specific information required:</u> location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information	Education & awareness raising Activity surveillance.
Recreational boating: sail <i>Unquantified; localised, mainly around Tenby & Saundersfoot. Little / no traffic from Swansea Bay.</i>	<u>Physical disturbance:</u> displacement, collision, noise & visual									✓	✓	✓	<u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures <u>Operation specific information required:</u> location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information	Education & awareness raising Activity surveillance.
Recreational boating: canoeing <i>Infrequent; minimal.</i>	<u>Physical disturbance:</u> displacement, collision, noise & visual									✓	✓	✓	<u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures <u>Operation specific information required:</u> location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information	Education & awareness raising Activity surveillance.
Recreational boating: other non-mechanically	<u>Physical disturbance:</u> displacement, collision, noise & visual										✓	✓	<u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures <u>Operation specific information required:</u> location, extent, scale, frequency,	Education & awareness raising Activity surveillance.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects	Advice as to likely required action
													<i>Information necessary to further refine / tailor advice to specific operations</i>	
<p>powered craft (e.g. kite-surfing, board-sailing etc.)</p> <p><i>No information available.</i></p>													<p><i>timing and duration; relevant location-specific biotic and abiotic information</i></p>	
<p>Recreational boating: moorings</p> <p><i>Localised; mainly Tenby / Saundersfoot (ca. 400), Llansteffan / Ferryside (ca. 250) and Burry Port / Loughor (ca. 200).</i></p>	<p><u>Physical disturbance:</u> displacement, collision, noise & visual</p>	✓	✓			✓							<p><u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures</p> <p><u>Operation specific information required:</u> location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	<p>Treat new mooring developments as plan or project as appropriate.</p> <p>Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce.</p> <p>Secure appropriate management of moorings in open coastal locations</p>
<p>Recreational boating: anchoring</p> <p><i>No data available. Localised anchoring of recreational angling vessels; mainly NE Bay and lower estuaries.</i></p>	<p><u>Physical disturbance:</u> displacement, collision, noise & visual</p>	✓	✓			✓							<p><u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures</p> <p><u>Operation specific information required:</u> location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	<p>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 (i.e. outwith MHPA port limits) used as commercial anchorages and for casual recreational anchoring</p>
<p>Scuba diving, snorkelling</p> <p><i>No data available; limited predominantly to rocky areas in SW and SE of Bay. Associated boat activity included above</i></p>	<p><u>Physical disturbance:</u> displacement noise & visual</p> <p><u>Other factors:</u> removal of target species</p>	✓	✓			✓							<p><u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures</p> <p><u>Operation specific information required:</u> location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</p>	<p>Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.</p>
<p>Spearfishing</p>	<p><u>Physical disturbance:</u> displacement</p>	✓	✓			✓							<p><u>Conservation status of typical species & species features:</u> disturbance and</p>	<p>Enforcement of relevant</p>

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
<i>No information available.</i>	noise & visual <u>Other factors:</u> removal of target species												modification of range and behaviour of vertebrate species; local modification of benthic species population structures <i>Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	legislation. Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.
Coastal access for recreation (bathing, dog walking, coasteering etc.) <i>Substantial; seasonally skewed; spatially variable. Numbers and spatial distribution unquantified.</i>	<u>Environmental quality:</u> organic enrichment, microbial pathogens, persistent inert materials <u>Physical disturbance:</u> general physical effects; trampling; noise; visual	✓	✓	✓	✓	✓				✓	✓	✓	<u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species composition <i>Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Education & awareness raising
Vehicles on foreshore <i>Widespread, occasional; unquantified observations.</i>	<u>Geophysical regime:</u> substrate <u>Physical disturbance:</u> crushing collision, noise; visual	✓	✓	✓	✓	✓				✓		✓	<u>Structure & function:</u> modification of habitat sedimentology, geomorphology, sediment processes <u>Conservation status of typical species & species features:</u> local modification of benthic species composition and population structures, particularly sediment habitats; disturbance and modification of range and behaviour of vertebrate species <i>Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Activity surveillance Education & awareness raising Appropriate implementation of SSSI procedures & access byelaws
Light aircraft <i>Occasional</i>	<u>Physical disturbance:</u> noise & visual										✓	✓	<u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species <i>Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Activity surveillance
Wildfowling <i>Unquantified observation; assumed to be widespread and common. Foreshore lease maps available.</i>	<u>Environmental quality:</u> metals, persistent inert materials <u>Physical disturbance:</u> crushing; noise; visual	✓	✓	✓	✓	✓				✓	✓	✓	<u>Structure & function:</u> modification of sediment chemistry (heavy metal contamination); habitat modification (manipulation to encourage target species) <u>Conservation status of typical species & species features:</u> local modification of sediment benthic species population structures, particularly sediment habitats; disturbance and modification of range and behaviour of vertebrate species <i>Operation specific information required: location, extent, scale, frequency,</i>	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

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
													<i>timing and duration; relevant location-specific biotic and abiotic information</i>	byelaws
Marine wildlife watching / eco-tourism <i>No data available</i>	<u>Physical disturbance:</u> noise & visual									✓	✓	✓	<u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species <u>Operation specific information required:</u> <i>location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Activity surveillance
MILITARY ACTIVITIES														
Military activity: ordnance ranges* <i>Regular</i>	<u>Environmental quality:</u> metals, persistent inert materials <u>Physical disturbance:</u> noise; visual	✓	✓	✓			✓	✓		✓	✓	✓	<u>Structure & function:</u> modification of water quality <u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species; potential effects of contaminants on physiological health <u>Operation specific information required:</u> <i>location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Research potential effects on features
Military activity: marine exercises <i>Unknown</i>	<u>Environmental quality:</u> metals, persistent inert materials <u>Physical disturbance:</u> noise; visual	✓	✓				✓	✓		✓	✓	✓	<u>Structure & function:</u> modification of water quality <u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species <u>Operation specific information required:</u> <i>location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Research potential effects on features
Military activity: aircraft <i>Regular</i>	<u>Physical disturbance:</u> noise & visual					✓				✓	✓	✓	<u>Conservation status of typical species & species features:</u> disturbance and modification of range and behaviour of vertebrate species <u>Operation specific information required:</u> <i>location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Activity surveillance
MISCELLANEOUS OPERATIONS AND USES														
Marine archaeology & salvage <i>No data available</i>	<u>Fundamental environmental parameters:</u> turbidity <u>Environmental quality:</u> metals <u>Physical disturbance:</u> displacement, abrasion, crushing, amputation, noise; visual	✓	✓	✓	✓	✓						✓	<u>Structure & function:</u> potential local modification of sedimentology and sediment transport, geomorphology, water quality (mobilisation of contaminants) <u>Conservation status of typical species & species features:</u> local modification of species population structures <u>Operation specific information required:</u> <i>location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	Education & awareness raising
Education <i>Regular use of favoured sites</i>	<u>Physical disturbance:</u> displacement, crushing, noise, visual <u>Other factors:</u> species removal	✓	✓	✓	✓	✓				✓			<u>Structure & function:</u> local modification of geomorphology, biological interactions <u>Conservation status of typical species & species features:</u> local modification of benthic species population structures; disturbance and modification of range and behaviour of vertebrate species <u>Operation specific information required:</u> <i>location, extent, scale, frequency,</i>	Review, develop and/or implement and monitor best practice suitable to secure features at FCS Appropriate implementation of SSSI procedures & access

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadows	Salicornia	Mud and sandflats	Subtidal sandbanks	Shads	Lampreys	Otters	Carmarthen Bay SPA	Burry Inlet SPA	Most likely relevant components & effects <i>Information necessary to further refine / tailor advice to specific operations</i>	Advice as to likely required action
													<i>timing and duration; relevant location-specific biotic and abiotic information</i>	byelaws Development and encouragement of information exchange
Science research <i>NRW, Uni. of Wales. Benthic, fish stock & water column sampling. Scoter aerial monitoring. Low tide waterfowl surveys.</i>	<u>Physical disturbance</u> :: displacement, crushing, noise, visual <u>Other factors</u> : species removal	✓	✓	✓	✓	✓				✓			<u>Structure & function</u> : local modification of geomorphology, biological interactions <u>Conservation status of typical species & species features</u> : local modification of benthic species population structures; disturbance and modification of range and behaviour of vertebrate species <u>Operation specific information required</u> : <i>location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	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 <i>Bird 'hospitals' located Gower & South Pembrokeshire</i>	<u>Environmental quality</u> : potential release of microbial pathogens <u>Physical disturbance</u> : noise, visual <u>Other factors</u> : habituation of wild species to humans									✓	✓	✓	<u>Conservation status of species features</u> : 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 <u>Operation specific information required</u> : <i>location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</i>	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 Carmarthen Bay & Estuaries EMS feature map: interpretation guide

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

- **Mudflats and sandflats** not covered by seawater at low tide
- **Sandbanks** which are slightly covered by seawater all the time
- **Large Shallow Inlets and Bays**
- **Estuaries**
- **Atlantic Salt Meadow** (*Glauco-Puccinellietalia maritimae*)

All feature definitions are taken from the “Interpretation Manual of European Union Habitats⁶⁰”

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.

Mudflats and Sandflats:

The feature extent outline for the mudflats and sandflats feature is based on the following information sources:

- CCW Phase 1 Intertidal Habitat Map
- Admiralty Charts
- Expert knowledge

No changes in total feature extent have been made except where data errors (e.g. unaligned polygon feature edges) existed in the original map.

⁶⁰ http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

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

Sandbanks

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

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

Helwick Bank is the only notified sandbank within Carmarthen Bay and Estuaries SAC. The extent of this feature has not been amended since site designation.

Large Shallow Inlets and Bays

Only one Large Shallow Inlet and Bay feature is present in Carmarthen Bay and Estuaries SAC, namely Carmarthen Bay. No changes have been made to the extent of this feature since site designation. The bay uses the landward boundary of the SAC on the coast and a closing line between the bounding headlands.

Estuaries

The estuary feature extents for Carmarthen Bay and Estuaries SAC (namely the Three Rivers and Bury Inlet) are derived from the inland boundary of the SAC and closing lines between bounding headlands at the estuary mouths. No changes have been made to the extent of these features since site designation.

Atlantic Salt Meadow

The Atlantic Salt Meadow feature extent for Carmarthen Bay and Estuaries SAC has been derived from CCW Phase 1 intertidal survey data, CCW Phase 2 vegetation mapping survey data and CCW sand dune vegetation survey data. Slight amendments have been made to the dataset to improve feature accuracy since it was delineated at the time of site designation (i.e. using newer data that had become available as part of the Article 17 reporting process).

Salicornia

The *Salicornia* feature extent for Carmarthen Bay and Estuaries SAC has been derived from CCW Phase 1 intertidal survey data, CCW Phase 2 vegetation mapping survey data, and CCW sand dune vegetation survey data. Slight amendments have been made to the dataset to improve feature accuracy since being delineated at the time of site designation (i.e. using newer data that had become available as part of the Article 17 reporting process).

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 (<i>cf</i> biomagnification <i>qv</i>).
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 <i>et al</i> 1998). Biogenic reefs – long-lived, hard, biological structures comprised of large numbers individual organisms such as mussel or sand-tube building worms <i>Sabellaria</i> .
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 (<i>cf</i> bioaccumulation <i>qv</i>).
biotic and abiotic factors (<i>qv</i>)	<p>Biotic: "Pertaining to life ... influences caused by living organisms", <i>cf</i> abiotic: "characteristics and elements of the environment (which) influence survival or reproduction of organisms, that are not alive themselves" (Baretta-Bekker <i>et al</i> <i>ibid</i>)</p> <p>Influences and elements of both a biological and non-biological nature that:</p> <ul style="list-style-type: none"> • contribute to the composition of a habitat, its structure, function or biology (<i>i.e.</i> the factors that the comprise habitat, as defined in Habitats Directive, Article 1f: "<i>habitat of a species</i> 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. <p>Many factors are <i>processes</i> (<i>qv</i>)</p> <p>Biotic factors include competitive interaction (e.g. for space and food, predation, scavenging and grazing).</p>
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 <i>et al</i> <i>ibid</i>)
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	(<i>degrade</i> : to lower in rank or grade, to lower in character, value or position or in complexity; <i>degraded</i> : declined in quality or standard. <i>Chambers Dictionary</i> 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>i.e.</i> 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; <i>cf</i> infauna (<i>qv</i>)
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 (<i>qv</i>) 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: <ul style="list-style-type: none"> • 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. <p><i>Many factors are processes (qv)</i></p>
functions	Functions are processes that may, directly or indirectly, influence: <ul style="list-style-type: none"> • 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 <i>et al ibid</i>)
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 <i>et al ibid</i>)
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) (<i>Multiple references</i>)
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: <ul style="list-style-type: none"> • 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 of 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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:

- Tenby Cliffs & St.Catherine's Island
- Waterwynch Bay to Saundersfoot Harbour
- Arfordir Saundersfoot – Telpyn/Saundersfoot – Telypyn Coast
- Afordir Marros – Pentwyn/Marros – Pendine Coast
- Twyni Lacham – Pentwyn/Laugharne – Pendine Burrows
- Whitehill Down
- Aber Taf/Taf Estuary
- Afon Tywi
- Arfordir Pen-bre/Pembrey Coast
- Burry Inlet and Loughor Estuary
- Twyni Chwitffordd, Morfa Landimor a Bae Brychdwn/Whiteford Burrows, Landimore Marsh and Broughton Bay

SPAs that are partly or wholly within the SAC:

- Bae Caerfyrddin/Carmarthen Bay
- Burry Inlet

Locations are shown on the feature map.

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)	<p>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.</p> <p><i>Tidal range and rise</i> - 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.</p> <p><i>Tidal streams (currents)</i>: 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.</p> <p><i>Wave exposure</i>. 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.</p> <p><i>Residual current</i> 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.</p>
temperature (water)	<p>Water temperature strongly influences water chemistry and biological processes, such as reproduction and metabolism.</p> <p>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.</p> <p>Global processes (global warming, shifts in ocean currents), influenced by climate change, also influence local seawater temperature regime temporarily, seasonally or chronically.</p>
light intensity (ambient seabed and water column)	<p>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.</p>
Seston Concentrations and water transparency (clarity/ turbidity)	<p>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.</p> <p>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.</p>

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)	<p>Species richness is most likely to be applicable as a component of FCS for typical species of Habitat features.</p> <p>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.</p> <p>Biological variety is a key contributor to biodiversity and applies at both taxonomic and genetic levels.</p> <p>Species variety “typical” of different habitats is dependent on the ecological opportunities available (niche diversity), particularly the degree of stress from natural processes.</p> <p>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.</p>
POPULATION DYNAMICS	Species population dynamics are inherently important in maintaining viability of species populations and species variety.
POPULATION SIZE	
Population size (species abundance)	<p>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.</p> <p>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.</p> <p>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 particularly sensitive to anthropogenic disturbance or habitat degradation.</p>
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	<p>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.</p> <p>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.</p> <p>However, high biomass and low species variety may also be indicative of environmental stress or perturbation.</p> <p>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.</p>
Reproductive success	<p>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.</p> <p>Reproductive capability is a function of many factors including physiological health, temperature regime and population density. Reduced physiological health and other</p>

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: <ul style="list-style-type: none"> • 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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