Cyfoeth Naturiol Cymru
Natural Resources Wales

Assessing Sensitivity of Welsh Marine SAC and SPA Features to Non-Licensable Activities

Report No: 350

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Crynodeb Gweithredol

Comisiynodd Cyfoeth Naturiol Cymru astudiaeth i nodi sensitifrwydd cynefinoedd a nodweddion rhywogaethau morol symudol Ardaloedd Morol Gwarchodedig (AMG) yng Nghymru (yn benodol Ardaloedd Cadwraeth Arbennig (ACA) ac Ardaloedd Gwarchodaeth Arbennig (AGA)) i amrediad o weithgareddau didrwydded y nodwyd eu bod o bosib yn bresennol ar y nodweddion hyn neu'n rhyngweithio â hwy.

Cafodd y dull o ddiffinio sensitifrwydd nodwedd i weithgareddau didrwydded ei rannu yn nifer o dasgau allweddol:

- Diffinio'r gweithgareddau;
- Sefydlu'r sylfaen dystiolaeth ar gyfer y berthynas rhwng gweithgaredd a phwysau;
- Asesu addasrwydd y meincnodau pwysau sy'n sail i asesiadau sensitifrwydd pwysau a nodwedd presennol;
- Asesu sensitifrwydd nodweddion ACA ac AGA i'r pwysau sy'n codi o bob gweithgaredd;
- Poblogi matricsau sensitifrwydd ar gyfer AMG yng Nghymru ar sail y nodweddion penodedig cydrannol.

Bydd allbynnau'r astudiaeth, sy'n cynnwys cyfres o fatricsau sensitifrwydd, yn cael eu defnyddio i lywio gwaith y dyfodol sy'n asesu pa mor agored yw nodweddion i weithgareddau, ac yn y pen draw, datblygu ymyriadau rheoli (lle bo angen) i wella neu gynnal cyflwrnodweddion sy'n cael eu gwarchod ar draws rhwydwaith AMG Cymru.

Mae'r adroddiad hwn yn disgrifio'r fethodoleg a ddefnyddiwyd ac yn rhoi trosolwg o'r canfyddiadau allweddol, ynghyd â thrafodaeth ynghylch cyfyngiadau'r allbwn ac argymhellion ar gyfer y camau nesaf.

Executive Summary

Natural Resources Wales (NRW) commissioned a study to identify the sensitivity of habitats and mobile marine species features of Marine Protected Areas (MPAs) in Wales (specifically Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)) to a range of non-licensable activities which have been identified as potentially occurring on or interacting with these features.

The approach to defining feature sensitivity to non-licensable activities was divided into a number of key tasks:

- Definition of activities;
- Establishing the evidence base for activity-pressure relationships;
- Assessing the suitability of the pressure benchmarks which underpin existing feature-pressure sensitivity assessments;
- Assessing sensitivities of SAC and SPA features to the pressures arising from each activity; and
- Populating sensitivity matrices for Welsh MPAs based on the component designated features.

The outputs of the study, which includes a series of sensitivity matrices, will be used to focus future work assessing the vulnerability of features to activities and ultimately the development of management interventions (where needed) to improve or maintain the condition of features protected across Wales's network of MPAs.

This report describes the methodology used and an overview of the key findings, together with a discussion of the limitations of the output and recommendations for next steps.

1. Introduction

Natural Resources Wales (NRW) is responsible for ensuring that the environment and natural resources of Wales are sustainably maintained, enhanced and used, now and in the future. NRW are currently running the Wales Non-Licensable Activities project, which will examine the potential impacts of various non-licensable activities at a network scale in Wales. The project seeks to develop the evidence base on the potential impacts, spatial and temporal distribution and intensity of activities and management options for those activities which affect features protected in the MPA network. The Wales Non-licensable activities project will feed into a wider programme of work to improve the condition of MPAs in Welsh Waters by implementing effective management and is linked to the Welsh MPA Management Framework and Action Plan.

This study represents the first phase of work in the Wales Non-Licensable Activities project and is designed to provide a broad scale picture of the potential sensitivity of MPA features (habitats and species) to a large range of non-licensable activities. This has been done by applying existing evidence available on activity-pressure links and feature sensitivity to help identify the non-licensable activities that may have the greatest potential for impacts on feature condition and conversely, those activities that may be of minimal concern. The activities assessed are limited to those which generally do not require a licence or permission under current marine legislation. Many of the activities are recreational activities or involve the collection of living resources.

The key tasks undertaken as part of this project include:

- Activity definition – defining the activities considered within this project and any associated assumptions;
- Activities-pressures – Establishing the linkages between the pressures that each of the activities give rise to, based on existing evidence sources;
- Suitability of the pressure benchmark – assessing the suitability of the pressure benchmarks which underpin existing feature-pressure sensitivity assessments;
- Assessing sensitivities of SAC and SPA features - populating sensitivity matrices for features of Welsh MPAs to the pressures arising from each activity; and
- Site-specific sensitivity – populating sensitivity matrices for Welsh MPAs based on the component designated features.

The outputs of the project will be used to focus future work assessing the vulnerability of features to activities and ultimately the development of management interventions (where needed) to improve or maintain the condition of features protected across Wales's network of MPAs.

The report is structured according to the following key sections:

- Section 1: Introduction (this section);
- Section 2: Method;
- Section 3: Assumptions and limitations; and
- Section 4: Key findings.

The outputs of the study include a series of matrices showing the links between activities and pressures, and the maximum feature sensitivity and site sensitivity to each of the activities. Due to limitations identified with some of the outputs (described in Sections 3 and 4, the output matrices have not been published for general use. However, this report describes the methodology development, to inform interested stakeholders and to enable NRW to update the outputs as and when required.

2. Method

The approach to defining feature sensitivity to non-licensable activities was divided into a number of key tasks:

- Definition of activities;
- Establishing the evidence base for activity-pressure relationships (i.e. the specific pressures which arise from each activity);
- Assessing the suitability of the pressure benchmarks which underpin existing feature-pressure sensitivity assessments;
- Assessing sensitivities of SAC and SPA features to the pressures arising from each activity; and
- Populating sensitivity matrices for Welsh MPAs based on the component designated features.

Further detail on each of these steps is included within the subsequent sections below. The work built on previous studies that have been undertaken in this field to ensure consistency with wider approaches.

The overall approach to considering both marine benthic (seabed) habitats and mobile features (including fish, cetaceans, seals and birds) was essentially the same and is shown in Figure 1 and 2.

The only difference was in the last step of the process which took account of the fact that the final sensitivity of Annex I habitats (Habitats listed under Annex 1 of the EU Habitats Directive (92/43/EEC))was based on the highest sensitivity of the habitat's component biotopes (described further in Section 2).

Figure 1. Overall approach to assessing sensitivity of marine habitats

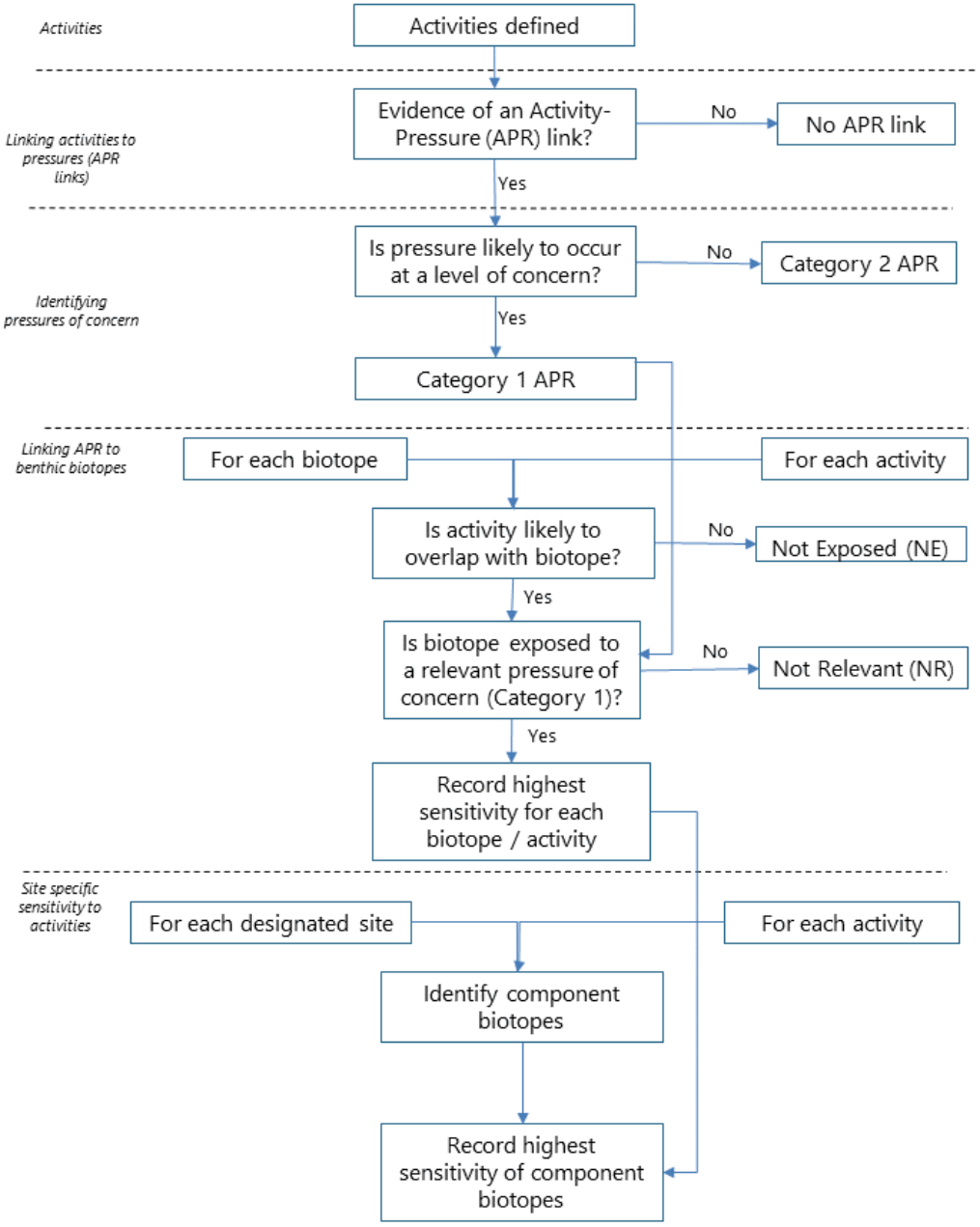

Image description

Begin with the activity definition - Linking activities to pressures (APR links). Is there evidence of an activity pressure (APR) link? If No - No APR link.

Identifying pressures of concern - If Yes, is pressure likely to occur at a level of concern? If No- Category 2 APR, if Yes, category 1 APR.

Linking APR to benthic biotopes - For each biotope, is activity likely to overlap with biotope? If No - Not exposed (NE). If Yes, is biotope exposed to a relevant pressure of concern (Category 1)? If No, not relevant (NR). If yes, record higher sensitivity for each biotope/activity.

Site-specific sensitivity to activities - For each designated site, identify component biotope and record highest sensitivity of component biotope for each activity.

Figure 2. Overall approach to assessing sensitivity of mobile features

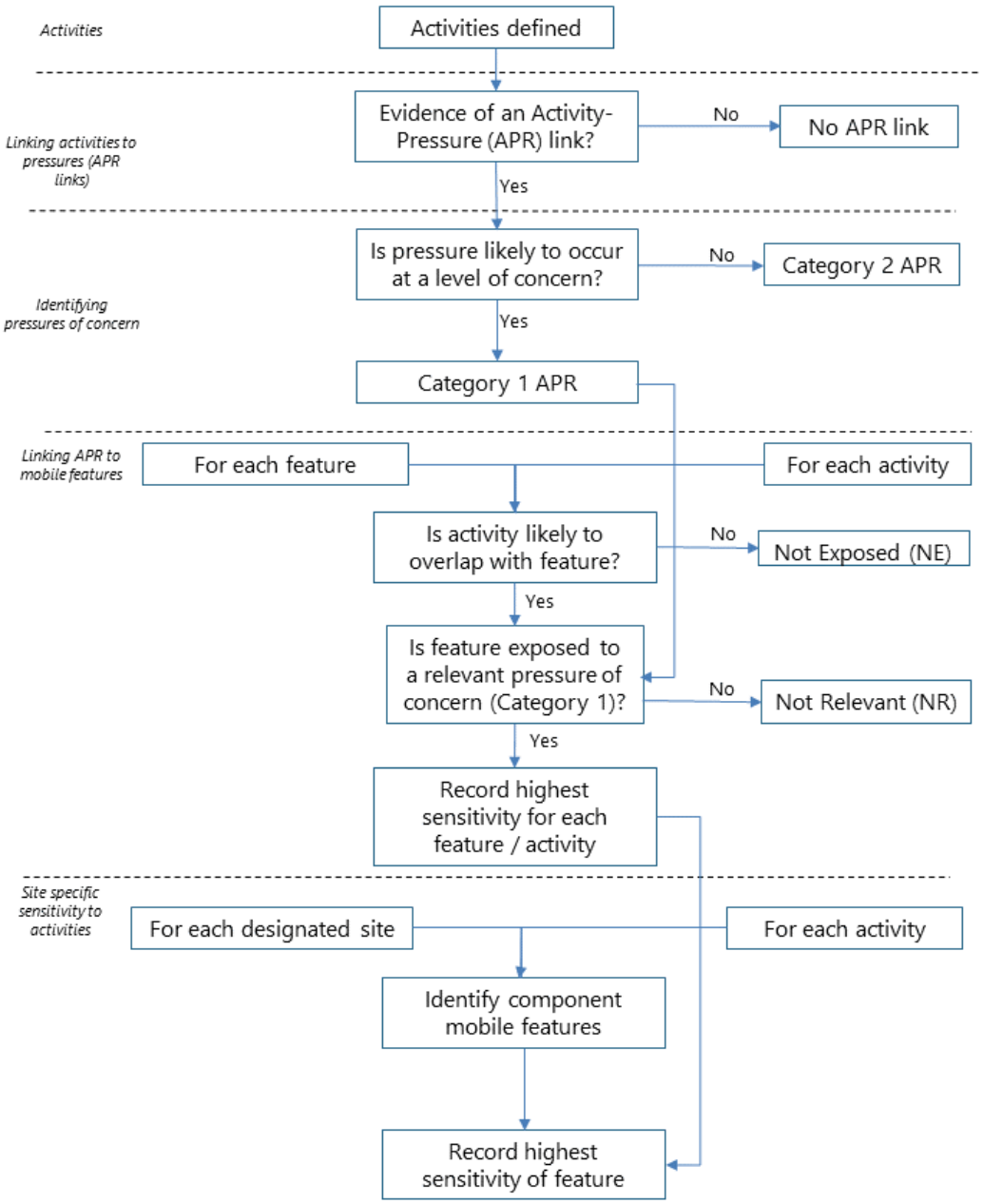

Image description

Begin with the activity definition - Linking activities to pressures (APR links) Is there evidence of an activity pressure (APR) link? If No - No APR link.

Identifying pressures of concern - If Yes, is pressure likely to occur at a level of concern? If No- Category 2 APR, if Yes, category 1 APR.

Linking APR to mobile features - For each feature, is activity likely to overlap with feature? If No - Not exposed (NE). If Yes, is feature exposed to a relevant pressure of concern (Category 1)? If No, not relevant (NR). If yes, record higher sensitivity for each feature/activity.

Site-specific sensitivity to activities - For each designated site, identify component mobile features and record highest sensitivity of feature.

Activity definitions

A total of 41 non-licensable activities have been considered within this project. The definition and assumptions associated with each activity is presented in Appendix A. This includes:

- A definition of each activity;
- The specific phase of an activity included within the definition and any assumptions regarding that phase of the activity;
- Assumptions with respect to where the activity is presumed to occur; and
- Further description of the activity-pressure link and any assumptions regarding the pressures arising.

The definition of each of the activities was, as far as possible, consistent with previous studies including Natural England (2017) and Natural England Advice on Operations.

A number of activities represent what could be considered “component parts” (or phase) of an “entire activity”. This includes, for example, a distinction between *recreational boating participation and recreational boating – anchoring, mooring and launching*. As many of the activities required access on foot to the intertidal or shallow subtidal environment where the activity is conducted, a generic ‘foot access’ activity was also separated out within the definition of relevant activities (increasing the number of activities assessed to 42). This was done to enable a distinction to be made as to the particular elements of an activity (e.g. the foot access to the area where the activity takes place, or the activity *per se*) that may require management measures within a specific MPA (in a subsequent project phase).

Further to defining the activities, a **typical intensity** at which each activity is undertaken was also assigned. This was based on a high level consideration of the number of individuals (for activities which do not use watercraft or vehicles, for example, walking, beach leisure, coasteering) or individual watercraft/vehicles (for those activities using these forms of transport such as hovercraft, kayaking, boats etc.) which typically undertake an activity on any given occasion. Each activity was classified as typically being undertaken by:

- One or a few individuals or watercraft/vehicle together (or a relatively low number of participants); or
- Groups of people or watercraft/vehicle (or a relatively high numbers of participants).

The area over which an activity is typically undertaken on any given occasion was also considered as follows:

- Undertaken in a relatively small area: Individual or watercraft/vehicle assumed to travel less than 500 m; and
- Undertaken over a relatively large area: Individual or watercraft/vehicle assumed to travel more than 500 m.

An indicative intensity for each activity (low, medium or high) was then assigned to each activity based on the above categories. For example:

- An activity undertaken by a high number of people/vessels over a relatively small area was considered to be undertaken at **high intensity**;
- An activity undertaken by a low number of people/vessels over a relatively large area was considered to be undertaken at **low intensity**; or
- An activity undertaken by a high number of people/vessels over a relatively large area or an activity undertaken by a low number of people over a relatively small area was considered to be undertaken at a **medium intensity**.

Given the high level nature of this assignment, the resulting intensity categories were 'sense checked' and amended if expert judgement deemed this to be appropriate (e.g. based on knowledge of the activities).

The indicative intensities were only used in considering the applicability of pressure benchmarks (see page 17). They were not factored in to any of the further tasks which assessed sensitivity of features to pressures associated with each activity (See pages 18-24).

Linking activities to the resulting pressures

The next step in the assessment process was to review the evidence linking individual activities to the resulting pressures. A fixed list of pressures has been derived within OSPAR (The list of pressures used in this study is based on the pressure definitions developed by the Intersessional Correspondence Group on Cumulative Effects (ICG-C) - Amended 25 March 2011. Available online: Defra Pressures List v4 [accessed 27.02.19]) to ensure consistency in the way pressures are assessed and their impact on biodiversity evaluated. The full list of 39 pressures that has been considered in this project is included at Appendix B.

Three existing evidence databases (listed below) were reviewed to establish whether there was evidence of a link between each activity and pressure (hereafter referred to as an activity-pressure link):

1. Natural England, 2017. Managing marine recreational activities: a review of evidence (NECR242);

2. Natural England Advice on Operations; and

3. ABPmer and Cefas, 2015. Validating an activity-pressure matrix.

Where evidence of a link existed in any of these databases, the confidence in the evidence was noted and used to assign an initial confidence score to the activity-pressure link as follows:

- Evidence recorded with medium or high confidence = Medium-High Confidence; and
- Evidence recorded with low confidence, no confidence or based on an expert judgement = Low Confidence.

In general, where expert judgement has been used to indicate a link between an activity and a specific pressure, this has been assigned a low confidence unless the nature of the activity (e.g. the removal of a target species by angling), or regulations associated with it (e.g. the

legal requirement for vessels at anchor and in transit to have lighting), enable there to be a high confidence in the pressure arising from the activity.

The resulting activity-pressure links and associated confidence scores were captured in a spreadsheet that formed part of the deliverables of this project (Activity-Pressure matrix).

Identifying pressures of concern

Where evidence of an activity-pressure link was determined, a differentiation was made between those pressures that are likely/less likely to arise at a 'level of potential concern' from each activity. This was based on the Risk Profiling of Pressures (RPP) approach defined by Natural England. The RPP score ranks the pressures by the general risk they pose to the environment under normal conditions. For each of the pressures associated with the activity, the profile assesses whether the generic risk is "High to Medium" or "Low" defined as follows:

- High to Medium Risk – The pressure is commonly induced by the activity at a level that needs to be considered further as part of an assessment; and
- Low Risk - Unless there are evidence-based case or site-specific factors that increase the risk, or uncertainty on the level of pressure on a receptor, this pressure generally does not occur at a level of concern and should not require consideration as part of an assessment.

The RPP score was used to assign each of the activity-pressure links (determined in Page 15) as either a Category 1 or Category 2, defined as follows:

- **Category 1** – If the RPP in the Natural England Advice on Operations was **High to Medium Risk** and/or if the pressure arising from an activity had not been considered to be negligible in Natural England (2017), the pressure was considered to be commonly induced by the activity (excluding consideration of activity intensity and site-specific issues) at a level that needed to be considered further as part of this project; or
- **Category 2** – If the RPP in the Natural England Advice on Operations was **Low Risk** and/or if the pressure arising from an activity had been considered to be negligible in Natural England (2017), the pressure arising from the activity (excluding consideration of activity intensity and site-specific issues) was not considered to occur at a level of concern and hence was not considered further within this project.

The resulting outputs were captured in the Activity-Pressure matrix.

Where an activity was considered to commonly induce pressure(s) at a level of concern (i.e. a Category 1 pressure requiring further assessment), the sensitivity of benthic habitats and mobile features to that the pressure(s) was assessed as described on page 18 below. Where the pressure(s) arising from an activity was not considered likely to occur at a level of concern (i.e. a Category 2 pressure) the activity-pressure link was not considered further (i.e. assessing the sensitivity of benthic habitats or mobile features to the activity-pressure was not judged to be necessary).

Assessing the suitability of the pressure benchmark

Many existing sensitivity assessments to generic pressures (e.g. noise, abrasion etc.) refer to a benchmark level of the pressure. The aim of this task was to assess whether the activities included in this study were likely to result in a particular pressure at the specified benchmark.

The benchmarks used within this project were based on those that were initially developed as part of MB0102 (Tillin *et al*., 2010) which have since been developed by the Statutory Nature Conservation Bodies (SNCBs) and OSPAR. The pressure benchmarks were revised in 2014 and 2015. Full details are given in Tillin and Tyler-Walters (2015). Available online: https://www.marlin.ac.uk/assets/pdf/Finalised-pressure-benchmarks-May2015.pdf.

An initial brief review of these pressure benchmarks was undertaken, to assess their suitability and identify any limitations of applying them in their current form.

This review was primarily based on a previous review of benchmarks undertaken as part of the Defra ME5218 study (ABPmer and Cefas, 2015). However, it also included a judgement on the utility of the benchmark, for example, with regard to the likelihood of evidence being available to enable comparison of the pressure with the benchmark, the clarity of the benchmark or whether the benchmark would essentially preclude any activity where evidence of an activity-pressure link existed. The outputs of the review of the benchmarks are presented in Appendix C.

Each activity-pressure link was then assessed against the benchmarks as they currently stand (see Appendix C) to determine the likelihood of an activity reaching the benchmark pressure. This assessment considered whether the activity (undertaken at the indicative intensity determined in Activity definitions – page 14) had a low or a medium-high likelihood of resulting in pressure which meets the current benchmark. This assessment was based on judgement and considered the following:

- Where a pressure had been considered not to occur at a level of concern (i.e. assigned as ‘Category 2’; see Identiftying pressures of concern – page 16 – the pressure generated was automatically considered to have a low likelihood of reaching the benchmark.
- Where a pressure had been considered to be commonly induced by the activity at a level that needed to be considered further as part of an environmental assessment (i.e. assigned as ‘Category 1’; see Identifying pressures of concern – page 16), it was then assessed whether the pressure (arising from the activity conducted at the likely indicative intensity assigned I Activity definitions – page 14) would have a low likelihood or a medium-high likelihood of reaching the benchmark. This assessment was necessarily a high level qualitative judgement.

The outputs of the benchmark review and activity-pressure versus benchmark assessment were also captured in the Activity-Pressure matrix. It is important to note that, given the issues identified in the benchmark review and the qualitative nature of the judgement on the suitability of the pressure benchmarks, the outputs of this part of the assessment should be treated as indicative only. Given the limitations associated with this assessment, the outputs were not directly used in the next stages of the assessment process to determine feature and site sensitivity to the activity-pressures (see Sections 3 and 4).

Determining the sensitivity of features to the activity-pressures

The sensitivity of benthic habitats and mobile features to pressures arising from marine activities has previously been defined in MarLIN (2014) (MarESA database) and Natural England (2016) respectively. These data sets were used to assign the sensitivity of benthic habitats and mobile features to the pressures of concern (category 1 pressures) arising from each activity identified on page 16.

The sensitivity scores were captured in two matrices (one for benthic habitats and one for mobile features), structured so that each tab (representing a specific activity) listed all 39 pressures and all benthic habitat features (at biotope level) or all mobile species features of Welsh MPAs (Figure 3).

For benthic habitats, the sensitivity was recorded at biotope level (see Figure 3). In some instances, where the sensitivity of a particular biotope to a pressure had not been assessed in the existing MarESA database, an alternative biotope and its associated sensitivity was used as a proxy (with the appropriate proxy biotope identified by NRW). Where no suitable proxy biotope could be identified, this was highlighted as a data gap (Not Assessed (NA)) within the sensitivity matrix.

For mobile features, sensitivity was recorded at species level. For three mobile features for which sensitivity data was not available (Great cormorant, Mallard and Tufted duck), the sensitivity of proxy species (chosen based on having similar ecological and behavioural traits) to the relevant pressures were used.

Figure 3. Matrix showing the sensitivity score [and confidence in the sensitivity score] of three example biotopes (the matrix listed 347 biotopes in total) to pressures arising from general beach leisure

Key to sensitivity and Confidence score: H=High; M=Medium, L=Low, NA=Not Assessed, NR=Not Relevant.

Note: Figure is only showing the pressures judged to occur at a level of concern (i.e. Category 1 pressures). The figure also shows the assumptions made regarding the activity and the pressures arising from the activity.

Pressures	Pressure category (1 or 2)	LR.HLR.MusB	LR.HLR.MusB.MytB	LR.HLR.MusB.Cht	LR.HLR.MusB.Cht.Cht
Abrasion/disturbance of the substrate on the surface of the seabed	1		M [H]	H [L]	H [L]
Litter	1		NA [NR]	NA [NR]	NA [NR]
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	1		NR [NR]	NR [NR]	NR [NR]
Visual disturbance	1		NR [NR]	NR [NR]	NR [NR]

Activity assumptions
This activity occurs in littoral and shallow subtidal (infralittoral) habitats (but not circalittoral habitats)
This activity may occur in any eulittoral and infralittoral habitat (i.e. rocky or sedimentary) except for mud habitats
Pressure assumptions
Abrasion/disturbance of the substrate on the surface of the seabed is a relevant pressure in eulittoral and infralittoral habitats (but not supralittoral habitats due to definition of pressure (i.e. affecting seabed))
Litter and Penetration and/or disturbance of the substrate below the surface of the seabed (including abrasion) arising from beach leisure are relevant pressure to eulittoral habitats but not infralittoral habitats (e.g. littering, digging in sand etc may occur in the intertidal but not shallow subtidal). Litter from other activities undertaken in the sea are dealt with under those activities.
Although a relevant pressure arising from this activity, there are no existing sensitivity assessments for pressures arising from littering (all assigned 'NA' = Not Assessed)
Visual disturbance is not a relevant pressure for benthic habitats

Image Description:

A matrix, which is a screenshot from Excel, showing the sensitivity score [and confidence in the sensitivity score] of three example biotopes (the matrix listed 347 biotopes in total) to pressures arising from general beach leisure. The three pressures are Abrasion/disturbance of the substrate of the surface of the seabed, Litter and Penetration and / or disturnbance of the substrate below the surface of the seabed, including abrasion. Visual disturbance is included but it is not relevant to any of the biotopes.

Once sensitivity scores had been extracted for all feature-pressure combinations as described above, a screening process was undertaken to assess:

- Whether the features were likely to be **exposed** to the activity (and hence the pressures arising from it). This was based on judgement regarding whether the activity and feature were likely to overlap. If it was judged that a feature would not be exposed to the activity, it was assigned as Not Exposed (NE); for example, subtidal benthic features were classified as Not Exposed to land-based activities; and
- Whether the Category 1 pressures **were likely to contribute to the feature's overall sensitivity** to the activity. For example, based on existing sensitivity assessments, Allis shad (a fish species) have a high sensitivity to 'Collision below water with static or moving objects not naturally found in the marine environment'. However, it was judged that this sensitivity was not likely to be related to collision with recreational watercraft; hence the sensitivity score was considered Not Relevant (NR) in assessing the features overall sensitivity to the activity.

Following compilation of the above data, the highest sensitivity score of each benthic and mobile feature to relevant Category 1 pressures arising from the respective activity was recorded, resulting in one of the following scores being assigned for each feature-pressure interaction (see Figure 4):

- NE Not exposed, the activity does not overlap with the feature. This was largely based on expert judgement;
- NC No pressures likely to occur at a level of concern (i.e. no Category 1 pressures);
- NR No relevant pressures – based on a review of the pressures identified as Category 1 none were considered relevant to the specific activity;
- NS Not sensitive - feature is not considered sensitivity to relevant Category 1 pressures;
- NA Not assessed – no available sensitivity information for the feature-pressure interaction;
- H High sensitivity to pressure;
- M Medium sensitivity to pressure; and
- L Low sensitivity to pressure.

Figure 4. Matrix showing the highest sensitivity score of benthic habitat biotopes exposed to relevant Category 1 pressures arising from general beach leisure (Benthic Sensitivity Matrix)

Key to sensitivity and Confidence score:

H=High; M=Medium, L=Low, NA=Not Assessed, NR=Not Relevant.

Pressures	Pressure category (1 or 2)	LR.HLR.MusB	LR.HLR.MusB.MytB	LR.HLR.MusB.Cht	LR.HLR.MusB.Cht.Cht	LR.HLR.MusB.Cht.Lpyg	LR.HLR.MusB.Sem	LR.HLR.MusB.Sem.Sem
Abrasion/disturbance of the substrate on the surface of the seabed	1		M [H]	H [L]	H [L]	H [L]	M [H]	M [H]
Litter	1		NA [NR]	NA [NR]	NA [NR]	NA [NR]	NA [NR]	NA [NR]
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	1		NR [NR]	NR [NR]	NR [NR]	NR [NR]	NR [NR]	NR [NR]
Visual disturbance	1		NR [NR]	NR [NR]	NR [NR]	NR [NR]	NR [NR]	NR [NR]
Feature exposed to specific activity		Y	Y	Y	Y	Y	Y	Y
Feature exposed to relevant pressure categories			Y	Y	Y	Y	Y	Y
Highest sensitivity score for relevant pressure categories		NA	M	H	H	H	M	M

Image description:

Matrix showing the highest sensitivity score of benthic habitat biotopes exposed to relevant Category 1 pressures arising from general beach leisure. This is taken from the Benthic Sensitivity Matrix, which is available as an Excel document. There are 6 biotopes which are used as examples in this matrix and the same pressures are used as in the previous figure. The matrix then shows if the biotope could be exposed to a specific activity, whether the feature is exposed to the relevant pressure categories and finally, what the highest sensivitity score is for the relevant pressure categories. The sensitivity scores range from N/A to High.

Identification of the feature's maximum sensitivity to an activity

From the above data, the maximum sensitivity score for each feature, to all relevant Category 1 pressures arising from each activity, were captured in spreadsheets that formed part of the deliverables of this project (the Benthic Max Sensitivity Matrix and the Mobile Max Sensitivity Matrix). It should be noted that, as the above assessment was partly dependent on expert judgement (in particular in the assessment of whether each feature would be exposed to the activity) it was not possible to assign confidence scores to the highest sensitivity identified for each activity-pressure-feature interaction. Extracts of the summary matrices are shown in Figure 5 and 6 below.

Figure 5. Extract of the Benthic Max Sensitivity Matrix showing the maximum sensitivity of eight benthic biotopes to eight activities

Key to sensitivity scores: H=High; M=Medium, L=Low, NA=Not Assessed, NR=Not Relevant.

Note: The coloured cells highlight biotopes for which there were no sensitivity assessments in the MarESA database.

Pink highlight (biotope LR.HLR.MusB) - no suitable proxy was identified and the sensitivity was classified as Not Assessed (NA) if the activity and feature were judged to overlap, or Not Exposed (NE) if the activity and feature were not judged to overlap.

Blue highlight (4 biotopes) - the sensitivity presented is for a proxy biotope.

	LR.HLR.MusB	LR.HLR.MusB.MytB	LR.HLR.MusB.Cht	LR.HLR.MusB.Cht.Cht	LR.HLR.MusB.Cht.Lpyg	LR.HLR.MusB.Sem	LR.HLR.MusB.Sem.Sem	LR.HLR.MusB.Sem.FvesR
Walking (recreational)	NA	M	H	H	H	M	M	M
Foot access (to conduct activity)	NA	M	H	H	H	M	M	M
Dog walking	NA	M	H	H	H	M	M	M
Horse riding	NE	NE	NE	NE	NE	NE	NE	NE
Cycling	NE	NE	NE	NE	NE	NE	NE	NE
Coastal cliff climbing	NE	NE	NE	NE	NE	NE	NE	NE
Coasteering	NA	M	H	H	H	M	M	M
Diving	NE	NE	NE	NE	NE	NE	NE	NE

Image description:

Extract of the Benthic Max Sensitivity Matrix shows the maximum sensitivity of eight benthic biotopes to eight activities; walking, foot access (to conduct an activity), dog walking, horse riding, cycling, coastal cliff climbing, coasteering and diving. The maximum sensitivities range from Not assessed to High.

Figure 6. Extract of the Mobile Max Sensitivity Matrix showing the maximum sensitivity of nine mobile MPA features (species) to eight activities

Key to sensitivity:

NE - Not exposed, the activity does not overlap with the feature. This was largely based on expert judgement;
NC - No pressures likely to occur at a level of concern (i.e. no Category 1 pressures);
NR - No relevant pressures – based on a review of the pressures identified as Category 1 none were considered relevant to the specific activity;
NS - Not sensitive - feature is not considered sensitivity to relevant Category 1 pressures;
NA - Not assessed – no available sensitivity information for the feature-pressure interaction;
H - High
M - Medium
L - Low

	Bottlenose Dolphin Tursiops truncatus	Grey seal Halichoerus grypus	Harbour Porpoise Phocoena phocoena	Otter Lutra lutra	Allis shad Alosa alosa	Twaite shad Alosa fallax	River lamprey Lampetra fluviatilis	Sea lamprey Petromyzon marinus	Dunlin Calidris alpina
Personal watercraft	H	H	H	IE	H	H	H	H	H
Personal watercraft - launching	NE	NE	NE	NE	NE	NE	NE	NE	H
Hovercraft	H	H	H	IE	H	H	M	M	H
Tour boats	H	H	H	IE	H	H	M	H	H
Kayaking	NS	L	NS	NS	NE	NE	NE	NE	H
Paddleboarding	NS	L	NS	NS	NE	NE	NE	NE	H
Surfing	NC	NC	NC	NC	NC	NC	NC	NC	NC
Windsurfing and kite surfing	NS	L	NS	NS	NE	NE	NE	NE	H

Image description:

Extract of the Mobile Max Sensitivity Matrix showing the maximum sensitivity of nine mobile MPA features (Bottlenose dolphin, Grey seal, Harbour porpose, Otter, Allis shad, Twaite Shad, River lamprey, Sea lamprey and Dunlin) to eight activities (personal watercraft, personal watercradt – launching, Hovercraft, Tour boats, kayaking, paddleboarding, surfing, windsurfing).

Site specific sensitivity to activities

The final stage of the methodology was to link the feature-pressure sensitivity scores (compiled using the processes described in Section 2 (page 18 and 21)) to specific Welsh MPAs, based on the features (Annex I habitats and mobile species) for which each MPA was designated.

A list of Welsh SACs, candidate SACs and SPAs, and their component features, was provided by NRW. Using an automated search tool, the maximum sensitivity for each feature within each MPA was extracted from the benthic and mobile max sensitivity matrices (page 21).

For the SACs, the maximum sensitivity score for the Annex I marine habitats was determined through extraction of the maximum sensitivity score across all of the habitat's component biotopes, from the benthic max sensitivity matrix. For mobile species within the SACs, candidate SACs and SPAs this process was simpler as the automated tool just extracted the maximum sensitivity of the mobile features to each activity from the mobile max sensitivity matrix.

This resulted in a final matrix which showed the maximum sensitivity of all features within each MPA to each of the activities considered within this project (the Site Sensitivity Matrix)

Workshop

An internal NRW workshop was held on 28 February 2018 to discuss the overall approach to, and the preliminary results of, the above compilation of sensitivity assessments. This included reviewing all of the assumptions and limitations associated with each step of the method. The outcomes of these discussions are described in Section 3. A summary of the final deliverables from this project, which addressed all of the comments received throughout the project (i.e. on the interim deliverables, and arising from the workshop), is provided in Section 4.

Figure 7. Extract of the Site-Sensitivity Matrix showing the maximum sensitivity of three MPA's component marine features to 13 activities activity (final deliverable)

Push to Update			Recreational boating – Participation	Recreational boating – anchoring, mooring and launching	Commercial shipping – vessel movements	Commercial shipping – anchoring and mooring	Personal watercraft	Personal watercraft - launching	Hovercraft	Tour boats	Kayaking	Paddleboarding	Surfing	Windsurfing and kite surfing	Dinghies_participation
Special Area of Conservation	**Special Area of Conservation**	**Marine Feature**													
Y Fenai a Bae Conwy / Menai Strait and Conwy Bay	Menai Strait and Conwy Bay	Reef	M	M	NA	M	NR	M	NR	NR	NR	NR	NR	NR	NR
	Menai Strait and Conwy Bay	Mudflats and sandflats not covered by seawater at low tide	M	M	NA	M	NR	M	NR	NR	NR	NR	NE	NR	NR
	Menai Strait and Conwy Bay	Sandbanks which are slightly covered by seawater all the time	M	M	NA	M	NR	M	NR	NR	NR	NR	NC	NR	NR
	Menai Strait and Conwy Bay	Large Shallow Inlets and Bays	M	H	NA	H	NR	M	NR	NR	NR	NR	NR	NR	NR
	Menai Strait and Conwy Bay	Submerged or partially submerged sea caves	L	H	NR	H	NR	NE	NR	NR	NR	NR	NE	NR	NR
Dee Estuary / Aber Dyfrdwy	Dee Estuary	Atlantic salt meadows *Glauco-Puccinellietalia maritimae*													
	Dee Estuary	*Salicornia* and other annuals colonising mud and sand													
	Dee Estuary	Mudflats and sandflats not covered by seawater at low tide	M	M	NR	M	NR	M	NR	NR	NR	NR	NE	NR	NR
	Dee Estuary	Annual vegetation of drift lines													
	Dee Estuary	Estuaries	M	M	NA	M	NR	M	NR	NR	NR	NR	NE	NR	NR
	Dee Estuary	Sea lamprey *Petromyzon marinus*	H	NE	H	NE	H	NE	M	H	NE	NE	NC	NE	NE
	Dee Estuary	River lamprey *Lampetra fluviatilis*	H	NE	H	NE	H	NE	M	H	NE	NE	NC	NE	NE
Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau	Pen Llyn a'r Sarnau	Coastal lagoons													
	Pen Llyn a'r Sarnau	Estuaries	M	M	NR	M	NR	M	NR	NR	NR	NR	NE	NR	NR
	Pen Llyn a'r Sarnau	Large Shallow Inlets and Bays	M	H	NA	H	NR	M	NR	NR	NR	NR	NE	NR	NR
	Pen Llyn a'r Sarnau	Reef	M	H	NA	H	NR	M	NR	NR	NR	NR	NR	NR	NR
	Pen Llyn a'r Sarnau	Sandbanks which are slightly covered by seawater all the time	M	M	NA	M	NR	M	NR	NR	NR	NR	NC	NR	NR
	Pen Llyn a'r Sarnau	Atlantic salt meadows *Glauco-Puccinellietalia maritimae*													
	Pen Llyn a'r Sarnau	Mudflats and sandflats not covered by seawater at low tide	M	H	NR	H	NR	M	NR	NR	NR	NR	NE	NR	NR
	Pen Llyn a'r Sarnau	Submerged or partially submerged sea caves	L	L	NA	L	NR	NE	NR	NR	NR	NR	NE	NR	NR
	Pen Llyn a'r Sarnau	*Salicornia* and other annuals colonising mud and sand													
	Pen Llyn a'r Sarnau	Grey seal *Halichoerus grypus*	H	NE	H	NE	H	NE	H	H	L	L	NC	L	L
	Pen Llyn a'r Sarnau	Otter *Lutra lutra*	IE	NE	IE	NE	IE	NE	IE	IE	NS	NS	NC	NS	NS
	Pen Llyn a'r Sarnau	Bottlenose dolphin *Tursiops truncatus*	H	NE	H	NE	H	NE	H	H	NS	NS	NC	NS	NS

Image description:

Extract of the Site-Sensitivity Matrix showing the maximum sensitivity of three MPA's (Menai Strait and Conwy Bay, Dee Estuary and Pen Llyn a'r Sarnau) component marine features to 13 activities. This represents the final deliverable.

3. Assumptions and Limitations

There are a series of assumptions and limitations associated with each step of the method applied within this project. These all have the potential to influence the results and their application in subsequent project phases beyond the scope of this contract. The key assumptions and limitations are therefore documented below so that they can be factored in to the interpretation of the deliverables arising from this project.

Definition of activities

The list of non-licensable activities to be considered within this project was provided by NRW. The associated definitions and assumptions for each activity were verified at the outset of this project (see Appendix A). It would be possible to extend the scope of the approach used in this project to a wider list of activities should this be necessary.

As described on page 14, a number of activities represent what could be considered "component parts" of an "entire activity". This includes, for example, a distinction between the participation phase for several recreational activities (e.g. recreational boating, personal watercraft use and dinghy sailing) and the launch of the vessel or craft (and/or the anchoring or mooring of the vessel if relevant to that activity). The distinction between the phases is necessarily slightly arbitrary, for example, launching of a motorised vessel has assumed that the vessel engine has not been started, whilst the vessel is assumed to be underway (and hence in the participation phase) as soon as the engine is started. In reality, these phases of the activity will overlap.

Another example includes the requirement for participants to traverse the foreshore to access the specific intertidal or marine environment in which the activity is conducted. As such 'foot access (to conduct activity)' was also considered as a separate phase for all activities in which this occurs. However, it is acknowledged that in some instances there may be very little, if any distinction, between the pressures arising from an activity conducted on the foreshore and the 'foot access' phase of the activity (e.g. for walking, dog walking, bait digging and coasteering). Where the foot access and the activity have been considered to essentially give rise to the same pressures this has been noted in the activity definitions and assumptions in Appendix A. In these instances, however, it is still possible that foot access may overlap with a wider variety of biotopes than the actual activity itself (and hence the maximum sensitivity outputs to these different activity phases may still differ depending on the biotopes traversed).

The benefit of separating activities into component phases is that it allows a distinction to be made as to the particular elements of an activity that may require management measures within a specific MPA (in a subsequent project phase). This is, however, reliant on a consistent application of assumptions as to what is included within each activity. In contrast, for example, the education/scientific use of the marine environment activity is relatively all encompassing (including both shore and sea-based educational and/or scientific activities). It is therefore important to ensure that the definitions applied within this project are fully understood prior to any further interpretation of the results.

It should be noted that when defining an indicative level of intensity for each activity this was largely based on expert judgement. This information was not used in any subsequent step of

the method except for the review of the benchmarks which was again not used to derive the overall feature or site sensitivity scores.

Definition of pressures, activities-pressures linkages and activity feature overlaps

The list of pressures used within this project was based on the standardised list produced within OSPAR. This ensures consistency across the work streams undertaken by each of the SNCBs. It does, however, present a number of limitations with respect to their application.

The way in which each pressure is fully defined, for example, is very specific and does not necessarily readily apply to the pressures arising from all activities. One example, where a potential gap has been identified is the pressure(s) arising from boulder turning or rockpooling which it was noted at the workshop do not appear to be well captured by the existing pressure definitions. It is therefore possible that pressures of potential concern arising from activities (e.g. desiccation of the underside of boulders due to turning and not replacing) might not have been captured through the approach applied within this project. Hence, to ensure that this methodology is suitable for all activities considered in this report, it would be necessary to add to the list of OSPAR ICG-C pressures. Natural England, for example, added above water noise, above water collision and vibration to capture pressures relevant for mobile features such as marine mammals and birds. However, any modification to the definition of pressures could have implications for wider work streams and/or advice on operations that is currently provided by SNCBs and would need further consideration at a national level.

Furthermore, some pressure definitions determine the activity-feature overlap that can be assumed. For example, the definition of the pressure 'abrasion/disturbance of the substrate surface of the seabed', a key pressure of concern for benthic features, confined this pressure to being relevant to biotopes below mean high water (due to reference to the seabed). As such, sensitivity assessments in relation to this pressure for 'coastal' activities such as walking, dog walking, horse riding and cycling were limited to intertidal biotopes where it was judged such activities may occur. Other activities such as coastal cliff climbing could not be assessed in the context of this pressure as this activity would take place above mean high water. The assumptions regarding the overlap between all activities and benthic/mobile features are described in Appendix A.

The amount of evidence available to substantiate an activity-pressure relationship is also quite variable. There are a number of activity-pressure linkages where it is acknowledged that direct evidence is particularly lacking. This includes, for example, the production of litter and the transfer and/or spread of non-native species. There was also reportedly a lack of evidence with respect to the introduction of light and changes in suspended solids. Those activities where there was least evidence, with respect to the introduction of light, included vessel movements and the placement of structures. Similarly, there was limited evidence in relation to changes in siltation as a result of vessel movements and sampling. It should also be noted that no evidence does not mean the pressure does not arise from the activity.

Within this project the evidence base was largely reliant on the outputs of three former projects. Each of these projects reviewed the available literature to try and establish cause

and effect and highlighted limitations within this process. The reader is directed to the outputs of these studies regarding the evidence base limitations that they identified.

Benchmarks

A high level review of the suitability of existing pressure benchmarks was undertaken, building on a previous review of pressure benchmarks (ABPmer and Cefas, 2015) to briefly consider their suitability to inform the assessment of the sensitivity of Welsh MPA features to non-licensable activities. Pressures which did not arise from any of the activities being assessed (based on the existing activity-pressures databases) were not considered in the review.

In general, the main issues regarding the benchmarks for the pressures of interest in this study were:

- The wording of the benchmark was such that if the pressure was generated at any magnitude by an activity, technically the benchmark would be exceeded. Examples of such benchmarks included:
  - Abrasion/disturbance of the substrate on the surface of the seabed;
  - Collision ABOVE water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures);
  - Introduction of light;
  - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion;
  - Removal of non-target species; and
  - Removal of target species.
- The benchmark may be too specific in relation to the quantitative evidence required to assess exceedance. Examples of such benchmarks included:
  - Underwater noise changes; and
  - Visual disturbance.
- The benchmark does not appear to capture all of the potential elements of a pressure as it is defined. For example, for the pressure 'Collision BELOW water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures)' the benchmark is expressed in terms of tidal volume passing through an artificial structure, which does not apply to moving objects such as boats.

Given the limitations associated with the benchmarks, the outputs were not directly used in defining feature sensitivity in the assessment process applied in this project. They will, however, have contributed to the sensitivity scores assigned in the MarLIN (2014) and Natural England (2016) studies and therefore this potential under or overestimation of sensitivity in some cases needs to be born in mind when considering the outputs of this work.

Feature sensitivity and data gaps

The sensitivity scores associated with each habitat/mobile feature and pressure relationship were derived from MarLIN (2014) and Natural England (2016) respectively. These sensitivity assessments will have been developed based on the best available evidence that was published at the time and the reader is directed to the outputs of these studies regarding any limitations in the evidence that they identified. As with any assessments, new information

frequently becomes available that can be used to further refine specific outcomes and may help to further inform future work regarding potential management requirements for unregulated/partially regulated activities in MPAs.

There are also gaps in the underlying evidence base where sensitivity information is not available for all pressure-feature combinations. This was mitigated where possible in this study through the use of a proxy feature's sensitivity to a given pressure (the appropriate proxy features to use for biotopes were provided by NRW). Where a proxy feature's sensitivity has been used within the benthic or mobile feature assessments, this has been indicated within the output matrices. Where no proxy species or habitat was available, these remained as gaps within the sensitivity spreadsheets. Other data gaps included the lack of sensitivity assessments related to the pressure litter for benthic features.

The sensitivity assessments used within this study were based on generic sensitivities to a pressure (i.e. it did not consider the specific pressures arising from the respective activities). This necessarily results in the sensitivity scores being defined in relation to each pressure definition rather than being activity specific. As such, when a pressure-based sensitivity score is applied it can potentially give a false impression of the level of sensitivity to a pressure arising from a specific activity. For example, when defining sensitivity to underwater noise, no distinction is made between the level of noise generated by different activities such as piling, blasting, or varying vessel engine sizes. As such, in the present study, any feature that has previously been assessed as having a high sensitivity to underwater noise changes, will be recorded as having a high sensitivity to an activity that generates changes in underwater noise, regardless of the magnitude in changes in underwater noise. In practice, this may not be expected to be the case. Similarly, for example, in assessing the sensitivity of fish species to the pressure of 'collision below water' for the activity of recreational boating (participation phase) will result in a high sensitivity score being recorded because the definition of the pressure includes collision with static underwater structures (such as turbines) which is not relevant to recreational boating.

One of the biggest sensitivity data gaps related to the pressure litter. No sensitivity assessments for benthic biotopes to litter are available and hence although this pressure was considered relevant to some activities, no sensitivity score was available. In contrast, sensitivity scores of mobile features to litter were available. In the assessments, it was considered that the activities general beach leisure and angling were likely to be primary sources of litter on the coast/marine environment and hence for these activities, mobile feature sensitivity scores to this pressure was included in the results. Given that litter arising from general beach leisure or angling may enter the marine environment and be transported further offshore, it was considered that diving bird species that feed in the marine environment (as opposed to on the foreshore) may also be affected by litter arising from these activities. As such, some bird species such as Red-throated diver, Puffins, Storm petrels and Manx shearwaters were recorded as having a high maximum sensitivity to general beach leisure, as a result of the high sensitivity of these features to litter.

When assigning an overall sensitivity score to each activity-pressure-feature combination, in discussion with NRW, some feature-pressure sensitivity assessments were excluded from the maximum sensitivity score. These included sensitivity of benthic biotopes to 'introduction of INIS' and 'physical change in habitat' from the introduction of moorings. With regard to INIS, it was agreed that the presence of INIS in an area/MPA may not relate to e.g. recreational boating activity within the area/MPA and as such, potential management of this issue should be dealt with via another mechanism. With regard to the pressure 'physical

change of habitat' arising from the introduction of mooring blocks, all subtidal biotopes where this pressure may occur were categorised as having a high sensitivity to the pressure. As such, inclusion of this pressure was felt to artificially 'skew' the maximum sensitivity of biotopes to the anchoring/mooring activities of recreational or commercial vessels to high, which was not necessarily appropriate given that introduction of any new mooring blocks would be regulated via licensing. Hence the sensitivity to the 'physical change in habitat' pressure was excluded from the calculation of the overall sensitivity score in relation to anchoring and mooring of vessels, which instead was determined by the biotopes' sensitivity to the pressures 'abrasion/disturbance of the substrate on the surface of the seabed' and 'penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion'.

The over-arching sensitivity score for each activity-feature combination is based on the maximum sensitivity across all relevant pressures. This is effectively a precautionary approach to defining maximum sensitivity, however, it does not take in to account the number of pressures that contribute to the score. A feature could, for example, have a medium sensitivity to a number of pressures arising from a particular activity, as compared to a single high sensitivity value. Ultimately the level of intensity at which an activity is undertaken and the degree of overlap with a particular feature will influence whether the arising pressures are at a level of concern.

In addition, the sensitivity assessments do not take in to account any element of spatial or temporal variability that might be exhibited by marine features. It is possible, for example, that some features are highly sensitive at particular times of the year or stages of their lifecycle. In these instances, the assessments would be assumed to be precautionary and when reviewing potential management measures that might be required at an MPA site level this variability could be an important consideration. Similarly, the sensitivity matrices produced do not factor in the level of intensity at which particular activities are undertaken. This will again vary across a range of spatial and temporal scales.

4. Key Findings

The following sections highlight key outputs relating to the sensitivity assessment of benthic and mobile SAC and SPA features in Welsh MPAs. The limitations regarding these outputs that should be considered when interpreting the results are also described.

Benthic features

The Benthic Max Sensitivity Matrix records the maximum sensitivity of 347 biotopes to each of the activities. Given the high number of biotope-activity combinations, the results below provide a summary of the key findings.

Table 1 shows the number of biotopes that had a maximum sensitivity of high, moderate or low to the pressures of concern (i.e. Category 1 pressures) arising from each activity. Note, the table does not show the number of biotopes i) which were judged as not exposed to the activity (NE), ii) for which the pressures of concern were judged not to be relevant pressures (NR) or iii) for which there was no existing sensitivity assessment to the pressure(s) of concern (NA).

Table 1. Number of biotopes with high, moderate or low sensitivity to pressures arising from each activity

Activity	High	Moderate	Low
Education/scientific use	26	167	61
General beach leisure	17	79	72
Foot access	11	90	95
Recreational boating – launch/anchoring/ mooring	10	80	85
Commercial shipping – anchoring/mooring	10	78	63
Collection of shellfish (with tools)	10	39	46
Dog walking	9	40	48
Walking	9	40	48
Coasteering	8	68	44
Wildlife watching from shore	8	37	50
Bait collection via boulder turning	8	35	29
SCUBA diving from shore or a vessel	7	73	69
Hobby potting from a vessel (for personal consumption)	7	65	60
Dinghy – launch	5	18	42
Snorkelling	3	45	37
Bait collection via digging	3	25	0
Personal watercraft – launch	3	13	41
Netting from shore (for personal consumption)	2	12	16
Recreational boating – participation	1	49	44

Activity	High	Moderate	Low
Collection of shellfish (by hand)	0	8	5
Horse riding	0	2	9
Non-motorised vehicles on the beach/foreshore	0	2	9
Cycling (on the beach)	0	1	10
Commercial shipping – vessel movements	0	0	0
Personal watercraft – participation	0	0	0
Hovercraft	0	0	0
Tour boats	0	0	0
Kayaking	0	0	0
Paddleboarding	0	0	0
Surfing	0	0	0
Windsurfing and kite surfing	0	0	0
Dinghy sailing – participation	0	0	0
Coastal cliff climbing	0	0	0
Light aircraft – motorised	0	0	0
Light aircraft – non-motorised	0	0	0
Jet aircraft	0	0	0
Use of drones	0	0	0
Angling from shore	0	0	0
Angling from vessel	0	0	0
Bait collection – tiles/tubes	0	0	0
Collection Salicornia/samphire*	0	0	0
Acoustic surveys	0	0	0

* No sensitivity assessments were available for saltmarsh biotopes and hence the results shown are a function of current data gaps.

Activities that are relatively wide-ranging in their definition (e.g. education/ scientific use of the marine environment and general beach leisure) potentially overlap with a wide range of biotopes and hence are shown to have the highest number of biotopes with high or moderate sensitivity to the pressures arising from those activities. In considering the utility of these results for future work, it may be useful to consider whether the broadest activity category (education/scientific use) could be divided into sub-activities to help focus the outputs.

In contrast, the lack of sensitive biotopes to some activities reflects some of the limitations noted in Section 3. For example, for the activity ‘angling from the shore’, the pressures of concern arising from this activity were judged to be litter (e.g. from lost/entangled angling gear) and removal of target species. However, Table 1 shows that no biotopes were recorded as being sensitive to this activity and this is potentially misleading for the following reasons:

- There are no existing sensitivity assessments for biotopes to the pressure litter (i.e. all biotopes where this is a relevant pressure are recorded as Not Assessed (NA); and
- For the pressure 'removal of target species', the sensitivity assessment considers whether the removal of species in the biotope is likely to result in measurable effects on the biotope classification, structure (in terms of both biological structure and the physical structure, sometimes referred to as habitat complexity) and function. As the mobile finfish species targeted by angling are not key characterising species of benthic biotopes (i.e. are not species named in the biotope description or identified as important by the biotope description) the corresponding sensitivity assessments were judged not to be relevant to the current study and hence were recorded as Not Relevant (NR) in the sensitivity matrix.

Other activities where it was considered that the methodology may not have adequately captured potential impacts on benthic features included:

- Bait collection with tiles/tubes – it was noted that in Wales, sometimes rubber tyres are used instead of tiles and tubes and the potential for contaminants to leach out of the tyres into the sediment was queried. Contamination was not a pressure linked to this activity based on the evidence databases used (which only noted potential contamination arising from leaks/spills from vehicles or vessels, which were not considered part of this activity in this study);
- Rockpooling (considered as a component of general beach leisure) – although a relatively high number of biotopes were highlighted as having moderate to high sensitivity to general beach leisure (due to the high number of biotopes this activity may overlap with), it was considered that impacts specifically associated with rockpooling may have been underestimated. For example:
  - It was not possible to include the sensitivity of rockpool biotopes (features of littoral rock) to the removal of target or non-target species, due to the definition of these pressures which refer to the commercial exploitation of stocks (via harvesting, angling or scientific sampling) and the by-catch associated with these activities, which do not apply to rockpooling activities; and
  - The standard OSPAR list of pressures did not contain a pressure that adequately corresponded to the pressure caused by the failure to return the boulders to their original position, which would leave underboulder communities exposed to the air. This concern was also raised with respect to bait collection via boulder turning for the same reason.

Table 2 shows the biotopes which were recorded as having a high sensitivity to one or more activities. The results indicate that there are about 30 biotopes recorded as having high sensitivity to one or more activity. However, there are 196 biotopes recorded as having moderate sensitivity to one or more activity. As such, when considering how to best utilise the outputs of the current study, in addition to consideration of areas where activities overlap with highly sensitive biotopes, future work will likely need to consider the potential for cumulative effects arising from multiple activities occurring over benthic features with moderate sensitivities to the pressures generated.

Table 2. Benthic biotopes that have high sensitivity to one or more activity

Biotope Name	Biotope Code	No. of Activities
Phymatolithon calcareum maerl beds in infralittoral clean gravel or coarse sand	SS.SMp.Mrl.Pcal	11
Maerl beds	SS.SMp.Mrl	11
Oyster beds on shallow sublittoral muddy mixed sediment	SS.SMx.IMx.Ost	11
Ascophyllum nodosum and *Fucus vesiculosus* on variable salinity mid eulittoral rock	LR.LLR.FVS.AscVS	9
Ascophyllum nodosum on full salinity mid eulittoral mixed substrata	LR.LLR.F.Asc.X	9
Ascophyllum nodosum on full salinity mid eulittoral rock	LR.LLR.F.Asc.FS	9
Ascophyllum nodosum on very sheltered mid eulittoral rock	LR.LLR.F.Asc	9
Ascophyllum nodosum, sponges and ascidians on tide-swept mid eulittoral rock	LR.HLR.FT.AscT	9
Chthamalus montagui and *Chthamalus stellatus* on exposed upper eulittoral rock	LR.HLR.MusB.Cht.Cht	9
Chthamalus spp. and *Lichina pygmaea* on steep exposed upper eulittoral rock	LR.HLR.MusB.Cht.Lpyg	9
Chthamalus spp. on exposed upper eulittoral rock	LR.HLR.MusB.Cht	9
Modiolus beds on open coast circalittoral mixed sediment	SS.SBR.SMus.ModMx	6
Modiolus beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata	SS.SBR.SMus.ModT	6
Communities of circalittoral caves and overhangs	CR.FCR.Cv	5
Sponge communities on deep circalittoral rock	CR.HCR.DpSp	5
Macoma balthica and *Arenicola* marina in muddy sand shores	LS.LSa.MuSa.MacAre	4
Zostera noltii beds in littoral muddy sand	LS.LMp.LSgr.Znol	4
Nephtys hombergii and *Macoma balthica* in infralittoral sandy mud	LS.LMu.MEst.NhomMacStr	3
Zostera marina/*angustifolia* beds on lower shore or infralittoral clean or muddy sand	SS.SMp.SSgr.Zmar	3
Seapens and burrowing megafauna in circalittoral fine mud	SS.SMu.CFiMu.SpnMeg	3

Biotope Name	Biotope Code	No. of Activities
Yellow and grey lichens on supralittoral rock	LR.FLR.Lic.YG	3
Ceramium sp. and piddocks on eulittoral fossilised peat	LR.HLR.FR.RPid	2
Eunicella verrucosa and *Pentapora foliacea* on wave-exposed circalittoral rock	CR.HCR.XFa.ByErSp.Eun	1
Fucus serratus and piddocks on lower eulittoral soft rock	LR.MLR.BF.Fser.Pid	1
Fucus serratus on full salinity lower eulittoral mixed substrata	LR.LLR.F.Fserr.X	1
Mytilus edulis and piddocks on eulittoral firm clay	LR.MLR.MusF.MytPid	1
Mytilus edulis beds with hydroids and ascidians on tide-swept exposed to moderately wave-exposed circalittoral rock	CR.MCR.CMus.CMyt	1
Nephtys hombergii, *Macoma balthica* and *Streblospio shrubsolii* in littoral sandy mud	LS.LMu.MEst.NhomMacStr	1
Osmundea pinnatifida on moderately exposed mid eulittoral rock	LR.HLR.FR.Osm	1
Mussel beds on reduced salinity infralittoral rock	IR.LIR.IFaVS.MytRS	1

Whilst some of the biotopes highlighted in Table 2 would be expected to be highly sensitive to some activity-pressures, for example highly diverse sediment and rock biotopes and biogenic biotopes, it was queried (at the workshop) why some of the biotopes listed were highly sensitive. Such examples, and the reasons for the high sensitivity assessments included:

- Osmundea biotope (*Osmundea pinnatifida* on moderately exposed mid eulittoral rock) - the high sensitivity of this biotope related to the pressure of removal of non-target species during the activity of educational/scientific use (based on the pressure definition “by-catch associated with all fishing, harvesting and extraction activities”, which could include education/scientific use). The biotope sensitivity to the other pressures judged to be of concern (abrasion of seabed surface and removal of target spp.) were low;
- Mussel beds on reduced salinity infralittoral rock - the high sensitivity of this biotope relates to the definition of the pressure “removal of non-target species” during the activity of educational/scientific use, as described in the point above. The biotope has medium sensitivity to the pressures abrasion/disturbance of the substrate on the surface of the seabed and removal of target species; and
- Communities of circalittoral caves and overhangs – this biotope has high sensitivity to pressures abrasion/disturbance of the substrate on the surface of the seabed. Activities which may cause this pressure and were considered to potentially overlap with the biotope were anchoring for recreational boating and commercial ships, diving, hobby potting and education/scientific use. The biotope also has high sensitivity to the pressure removal of target-species, potentially arising from educational/scientific use activities occurring in this biotope.

Whilst Table 1 and Table 2 provide a useful starting point for identifying activities of potential concern that may require management and/or particularly sensitive biotopes, for the reasons stated above, there may be justification for further detailed review (beyond this study) of activity-pressures or feature sensitivity based on site-specific knowledge of where and how certain activities are conducted.

An example of the application of the habitat sensitivity project outputs is shown in Figure 8. In this figure, the sensitivity of benthic biotopes to the activity ‘foot access’ assessed in this study, have been spatially applied to biotopes mapped in Phase 1 Intertidal Surveys (conducted by the Countryside Council for Wales between 1996 and 2004). Similar maps could be produced for other activities by NRW in the future if required.

Figure 8. Example of potential application of benthic habitat sensitivity outputs to map sensitivity to specific activities

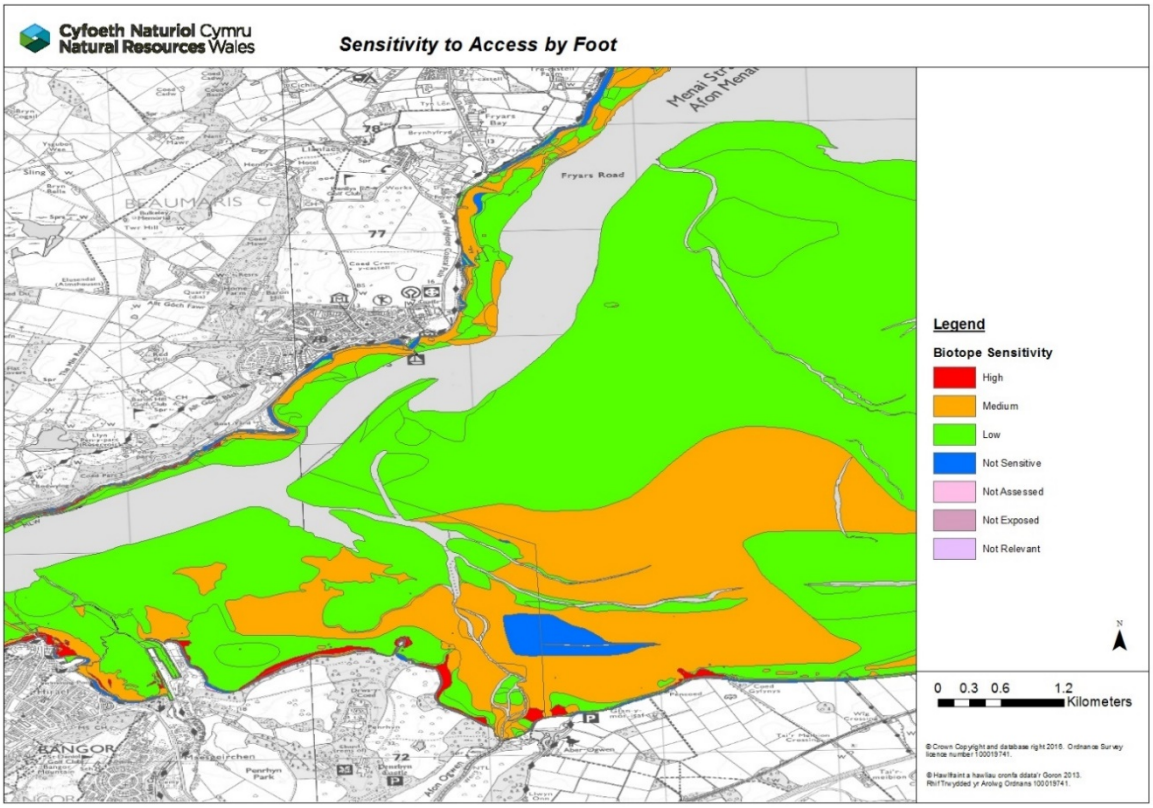

Image description

This map shows an area of Traeth Lafan, on the southern shore of the Menai Strait and the southern shore of Anglesey. The base map is the Phase 1 intertidal biotope layer, and it has been coloured up with 7 different colours, depending on the biotopes maximum sensitivity to pressures of foot acccess. The sensitivities are High, Medium, Low, Not sensitive, Not Assessed, Not exposed and Not relevant. The largest area of biotopes closest to the main channel are classed as low sensitivity shown in green, with another section of medium sensitivity in orange in the mid shore regions. There is narrow strip of biotopes which are of high sensitivity, on the mainland, close to the upper shore shown in red.

Mobile features

The maximum sensitivity of each of the 43 mobile features (species) to each of the 42 activities (including general 'foot access' for many of the activities) is presented in the Mobile Max Sensitivity Matrix. The results presented below provide a summary of the key findings.

Table 3 shows the number of mobile features that had high, moderate or low sensitivity to pressures of concern (i.e. Category 1 pressures) arising from each activity. Note, the table does not show the number of mobile features i) which were judged as not exposed to the activity (NE), ii) for which the pressures of concern were judged not to be relevant pressures

(NR) or iii) for which there was no existing sensitivity assessment to the pressure(s) of concern (NA).

Table 3. Number of mobile features with high, moderate or low sensitivity to pressures arising from each activity

Activity	High	Moderate	Low
Recreational boating – Participation	37	4	3
Angling from vessel	37	4	3
Commercial shipping – vessel movements	36	4	4
Personal watercraft	36	4	4
Tour boats	35	5	4
Hobby potting	34	6	4
Acoustic surveys	34	6	4
Education / scientific use of marine environment	34	6	4
Diving	32	7	5
Light aircraft - motorised	31	4	3
Jet aircraft	31	4	3
Hovercraft	30	5	4
Use of drones	29	4	4
Bait digging and collection – digging	29	2	0
Kayaking	25	8	3
Paddleboarding	25	8	3
Windsurfing and kite surfing	25	8	3
Dinghies_participation	25	8	3
Light aircraft – non- motorised	25	8	3
Walking (recreational)	25	6	3
Dog walking	25	6	3
Recreational boating – anchoring, mooring and launching	25	2	4
Personal watercraft - launching	25	2	4
Wildlife watching from shore	24	7	3
Collection of shellfish (using tools)	22	6	2
General beach leisure	21	14	4
Angling from shore	21	13	5
Bait digging and collection – tiles / tubes	21	13	5
Collection of Salicornia / samphire	21	7	2

Activity	High	Moderate	Low
Foot access (to conduct activity)	21	6	3
Horse riding	21	6	3
Netting	21	6	3
Dinghies_launching	21	6	2
Non-motorised vehicles on the beach and foreshore	21	6	2
Cycling	21	6	2
Collection of shellfish (hand gathering)	21	6	2
Coastal cliff climbing	12	0	1
Coasteering	12	0	1
Bait digging and collection – boulder turning	8	1	0
Snorkeling	0	0	1
Commercial shipping – anchoring and mooring	0	0	0
Surfing	0	0	0

In general, the maximum sensitivity for the mobile features was driven by their sensitivity to certain pressures, for example:

- Underwater noise changes and/or collision below water for cetaceans and fish species;
- Above water noise changes and/or visual disturbance for grey seals; and
- Above water noise changes, collision above water and/or visual disturbance for birds.

In considering the implications of these outputs for future work it is important to bear in mind the limitations described in Section 3. For example:

- Marine mammal sensitivity to noise is recorded as high (from the existing sensitivity assessments for mobile features). However, marine mammals are considered to have a low to moderate sensitivity to recreational vessel noise specifically, based on studies of their behavioural responses to recreational boating;
- Migratory fish are recorded as having a high sensitivity to collision (from the existing sensitivity assessments for mobile features). However, based on expert judgement in the context of this study, fish are considered to have a low sensitivity to collision with recreational craft. The high sensitivity assigned within Natural England (2016) is probably based on risk with respect to collision with turbines;
- The risk of collision of most diving birds with recreational vessels is considered to be low or not sensitive but is recorded as medium or high in the existing sensitivity assessments for mobile features;
- Visual disturbance for some features (such as grey seal) is scored as low but based on expert judgement in the context of this study, should be higher for certain activities such as personal watercraft or kayaking; and

- Nearly all bird species are scored as having high sensitivity to above water noise changes or visual disturbance. Hence in the current study most bird species are assigned a high sensitivity to any activity that creates above water noise or visual disturbance, which is most of the activities.

As such, further consideration of whether the outputs of the current study are appropriate for the aims of NRW with respect to management of non-licensable activities within MPAs for mobile features will be required (see Recommendations / next steps).

It can be noted that there were three activities to which no mobile features had a high or moderate sensitivity to the associated pressures of concern. These activities were:

- Snorkelling;
- Commercial shipping – anchoring/mooring; and
- Surfing.

These results reflect the assumption that any airborne noise generated by snorkelling or surfing was not likely to be above ambient noise levels and hence would not result in noise-related disturbance. In addition, the visual disturbance pressure arising from these two activities were not judged likely to be generated at a level of potential concern for mobile features due to the locations in which these activities were generally undertaken. With regard to commercial ships at anchorage, it was assumed that the vessel engines would not be operating and the vessels would be stationary and hence unlikely to generate any airborne/underwater noise or visual disturbance pressures of concern.

Recommendations/ next steps

The overall aim of NRW's work programme is to identify non-licensable activities that are having the greatest impact on the condition of features within MPAs and to identify and implement effective management to mitigate such impacts. This phase of the work was designed to apply existing evidence on activity-pressure links and feature sensitivity to help identify the non-licensable activities that may have the greatest impact on feature condition.

Review and discussion of the study outputs, including via a project workshop indicate that, whilst acknowledging the limitations described in Section 3, for benthic features, the results as they are presented (i.e. a series of matrices) do provide a useful tool to start prioritising which activities could be managed and in which locations. Further work will be required, however, to take in to account spatial overlap between the activities and features, along with activity intensity, within each MPA. There are also outstanding requirements with respect to filling gaps in the underlying evidence base. More specifically some pressures may need to be dealt with separately such as litter and non-native species to ensure that overall assessments are not skewed.

The direct applicability of the outputs for mobile features was, however, considered to be potentially more limited. This was largely due to the nature and applicability of the underlying evidence base as well as assumptions regarding the overlaps of the activities and the features (e.g. for different bird species). Specific recommendations as to how this can be progressed that have been identified are outlined below. These are in addition to the general requirement to consider the intensity and direct spatial and temporal overlap of activities (and the associated pressures) with features on a site by site basis.

In the specific context of birds, it will be important to determine the intensity of activities on a site specific basis and take in to consideration that SPAs were designated with disturbance already in place. It may also be more appropriate to reassess sensitivity of features to more generically defined pressures such as overall disturbance. This would include through the review of the literature, for example, relating to disturbance distances, impacts of disturbance on condition, threshold levels of disturbance that birds can cope with and flight initiation distances (FIDs), which would help to further distinguish between the relative sensitivity of different species to airborne noise and visual disturbance pressures. Such information could be used together with maps of feature distribution and activity intensity and distribution information (if available) to derive 'zones of potential disturbance influence'. Some kind of threshold or scoring criteria could then be applied to determine whether activities require further management. When considering sensitivity of marine mammals and fish to underwater noise, there is a requirement for a distinction to be made with respect to different sources of noise (e.g. generated by motorised vessels or piling etc.).

More generally the next phases of the project will need to fill gaps in the evidence base which are thought to be having the greatest impact on the results of this study. This could, for example, include addressing a number of limitations and assumptions that have been identified. A degree of prioritisation is likely to be required to ensure efforts are focussed where additional information can add the greatest value to the assessment process. To understand the scale of any potential adverse effects to the condition of MPA features as a result of non-licensable activities it will also be important to incorporate site-specific considerations. This will include the degree of spatial and temporal overlap of features with activities/pressures to which they are sensitive. Ultimately the outputs will be used to inform the development of management interventions (where needed) to improve or maintain the condition of features protected across Wales's network of MPAs.

The outputs from this project will need to be updated at intervals, as our understanding of links between activities and pressures and sensitivity of features develops. For this reason, the results are not presented in the appendices of this report. The Activity / Pressure spreadsheet can be requested from NRW (datadistribution@naturalresourceswales.gov.uk) and biotope sensitivity information is available from MarLIN in the form of the Marine Evidence-based Sensitivity Assessment (MarESA) data extract. The sensitivity of mobile features data was provided by Natural England and is therefore not available from NRW.

In conclusion:

- NRW will use the findings of this process (along with other methods and approaches) as a tool to help inform management of non-licensable activities;
- It is acknowledged that updated sensitivity information (and biotope codes) will become available at intervals which will affect the outputs of this work. The method / template presented in this contract allows for updates to be made, if and when this is required by NRW; and
- One application of the outputs of this project is the production of maps illustrating the sensitivity of biotopes (see Figure 8). It is anticipated that a further development could be to overlay these maps with activity-related spatial data, to provide information about areas that are potentially vulnerable to specific non-licensable activities.

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Abbreviations

AA	Annual Average
AMBI	AZTI Marine Biotic Index
APR	Activity Pressure
CD	Chart Datum
Cefas	Centre for Environment, Fisheries and Aquaculture Science
DDT	Dichlor-Diphenyl-Trichloroethane
EAC	Environmental Assessment Concentrations
EC	European Commission
EQS	Environmental Quality Standard
ER Ls	Environmental Risk Limits
FID	Flight Initiation Distance
GB	Great Britain
GBNNSIP	GB Non-native Species Information Portal
GM	Genetic Modification
H	High Sensitivity to Pressure
IAEA	International Atomic Energy Agency
ICG-C	Intersessional Correspondence Group on Cumulative Effects
INIS	Non-Indigenous Species
L	Low Sensitivity to Pressure
M	Medium Sensitivity to Pressure
MarESA	Marine Evidence Based Sensitivity Assessment
MarLIN	Marine Life Information Network
MNCR	Marine Nature Conservation Review
MPA	Marine Protected Areas
MS	Microsoft
MSFD	Marine Strategy Framework Directive

NA	Not Assessed
NC	No Concern
NE	Not Exposed
NR	Not Relevant
NRW	Natural Resources Wales
NS	Not Sensitive
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenols
PEL	Probably Effect Levels
PIC	Products of Incomplete Combustion
PWC	Personal Watercraft
ROV	Remotely Operated Underwater Vehicle
RPP	Risk Profiling of Pressures
SAC	Special Areas of Conservation
SEL	Sound Exposure Level
SNCB	Statutory Nature Conservation Bodies
SPA	Special Protection Areas
SPL	Sound Pressure Level
SUP	Stand Up Paddle Boarding
TBT	Tributyltin
TCDD	Tetrachlorodibenzo (p)Dioxin
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicles
UK	United Kingdom
UKTAG	United Kingdom Technical Advisory Group
WFD	Water Framework Directive

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendix A: Activity Definitions and Assumptions

Table A1. Activity definitions and assumptions

Activity	Definition	Activity Phase and Assumptions
Recreational boating – Participation	Motorised vessels (including motorboats, wakeboarding, water skiing and parascending but excluding personal watercraft and hovercraft) when underway/making way.	Vessel movement only (launching, anchoring or mooring excluded)
Recreational boating – anchoring, mooring and launching	Impacts of launching (e.g. from shore using a vehicle and trailer), mooring or anchoring of a motorised vessel (excluding personal watercraft and hovercraft)	Launch of motorised vessel, using a vehicle/trailer, not from an official slipway OR the anchoring/mooring of a motorised vessel
Commercial shipping – vessel movements	Commercial vessel, transporting freight and/or passengers, that is in transit	Pressures arising from commercial vessel movement only (launching, anchoring or mooring excluded). Assumed commercial shipping vessels have inboard engines (rather than outboard engines) and movements in shallow water are along maintained navigational channels. Excludes potential synthetic and non-synthetic contamination pressures arising from vessel maintenance (when removed from the water) which not part of shipping activity *per se*.
Commercial shipping – anchoring mooring	Commercial (non-recreational) vessels anchored or moored in coastal or offshore waters (i.e. not at a berth).	Pressures arising from anchoring or mooring only. Excludes pressures arising from commercial vessel movement
Personal watercraft (PWC)	A recreational watercraft that the rider rides or stands on, rather than being located inside of, for example, in a boat. Models have an inboard engine driving a pump jet that has a screw-shaped impeller to create thrust for propulsion and steering.	PWC use. Excludes the launch of PWC from unofficial launch points
Personal watercraft - launching	Impacts of launching a PWC from an unofficial launch site	Launch of PWC from an unofficial launch point only (e.g. using a trailer on the beach rather than on a slipway)
Hovercraft	A hovercraft, also known as an Air-Cushion Vehicle (ACV), is a craft capable of travelling over land, water, mud or ice and other surfaces.	The use of hovercraft in coastal waters for recreational cruising. Excludes hovercraft racing, which mainly conducted in inland waters. Also excludes commercial hovercraft use (which included under commercial shipping)
Tour boats	Water-based wildlife watching from a motorised vessel	Wildlife watching at sea from motorised vessels which depart/return to a berth at a harbour or marina (i.e. is not taken out of the water).Excludes potential synthetic and non-synthetic contamination pressures arising from vessel maintenance (when removed from the water) which not part of boating activity *per se*.
Kayaking	Watersport which involves the use of a paddle for propulsion. Includes sea kayaking, surf kayaking and sit-on-top kayaking	Participation. Excludes kayaks being used for surfing in the surf zone
Paddleboarding	Watersport which involves the use of a paddle for propulsion. Often referred to as stand up paddle boarding (SUP)	Participation. Excludes paddleboards being used for surfing in the surf zone

Activity	Definition	Activity Phase and Assumptions
Surfing	Watersport using a board (without a kite or sail) to ride surf waves. Includes surfing, bodyboarding and kneeboarding. Also includes kayaks or paddleboards being used to surf in the surf zone	Participation.
Windsurfing and kite surfing	Wind-based watersports using a kite or sail to propel the board.	Participation
Dinghies_participation	Small sailing boats which are usually taken out of water at end of use.	Participation
Dinghies_ launching	Impacts of launching (slipway or beach/shore launching which may include the use of trailers and vehicles).	Launch of non-motorised vessel
Non-motorised vehicles on the beach and foreshore	Non-motorised vehicles (craft) with sails used on the foreshore including sand yachting and sand buggying (kite buggying).	Participation
Walking (recreational)	Walking on the foreshore/intertidal	Participation
Foot access (to conduct activity)	Walking over the foreshore/intertidal to access the sea for an activity	Activity covers foot access to the participatory phase of all activities which require foot access to the sea and/or intertidal. Includes foot access with or without footwear.
Dog walking	Activities on the foreshore/intertidal that involve dogs	Excludes wildfowling where dogs are used
Horse riding	Activities on the foreshore/intertidal that involve horses	Participation
Cycling	Cycling (fat biking) on the foreshore/intertidal	Participation
Coastal cliff climbing	Sea cliff rock climbing	Participation
Coasteering	An activity that involves traversing along the intertidal, subtidal and supralittoral zones, using a combination of scrambling, walking, and swimming to complete the journey, without the aid of boats, surf boards or other craft. It often involves a series of jumps into deeper water	Participation
Diving	Swimming underwater using Self Contained Underwater Breathing Apparatus (Scuba) from the shore or from a motorised vessel	Travel to/from dive site in motorised vessel and participation in diving activity
Snorkeling	Swimming on the surface using snorkelling equipment.	Participation. Activity assumed to be undertaken from the shore (as opposed to from a motorised vessel)
Wildlife watching from shore	Land based wildlife watching	Participation

Activity	Definition	Activity Phase and Assumptions
General beach leisure	Activities undertaken on the foreshore including beach games, beachcombing, sunbathing, rockpooling and swimming	Includes all types of activities on the beach which includes walking with or without footwear
Light aircraft - motorised	All types of motorised craft used for recreation in the air including small planes, helicopters, paramotors and microlights	Participation
Light aircraft – non- motorised	All types of non-motorised craft used for recreation in the air e.g. hang gliding and paragliders	Participation
Jet aircraft	Aircraft propelled by jet engines, including civil and military aviation	Commercial civil aviation and military aviation activity
Use of drones	Unmanned aircraft systems (UASs) or unmanned aerial vehicles (UAVs), commonly known as drones, are aircraft without a human pilot aboard. Includes personal and commercial use	Drone use, operated from the shore
Angling from shore	Fishing from the using a rod and line or longline	Participation
Angling from vessel	Fishing at sea from a motorised vessel	Travel to/from angling site in motorised vessel and participation in angling activity. Assumed activity conducted by vessel kept in the water in a harbour or marina (i.e. no launching of vessel). Excludes potential synthetic and non-synthetic contamination pressures arising from vessel maintenance (when removed from water) as not part of activity *per se*.
Bait digging and collection – digging	Digging in the intertidal area for bait species including rag worm and lug worm	Participation
Bait digging and collection – tiles / tubes	Placement and collection of tiles/tubes in the intertidal to attract bait species (primarily shore crab)	Participation
Bait digging and collection – boulder turning	Turning over of boulders in the intertidal to harvest bait species (primarily shore crab)	Participation
Collection of shellfish (hand gathering)	Hand gathering of shellfish species (not fully regulated) for commercial or personal use	Participation
Collection of shellfish (using tools)	Collection of shellfish species (not fully regulated), using hand tools such as rakes and spades, for commercial or personal use	Participation. Assumed tools used include rakes and spades.
Netting	Fishing from the shore using a net to catch seafood for personal consumption	Participation (setting and hauling of nets)
Hobby potting	Fishing from a vessel using pots to catch seafood for personal consumption	Travel to/from potting location in a motorised vessel and setting/hauling of pots

Activity	Definition	Activity Phase and Assumptions
Collection of Salicornia / samphire	Hand gathering of saltmarsh plant species for personal consumption	Participation
Acoustic surveys	Surveys conducted from motorised vessels to study seabed topography, including sub-bottom profiling, bathymetric surveys, multibeam and sidescan sonar	Vessel movement and acoustic survey activity. Excludes pressures arising from anchoring or mooring of motorised vessels
Education / scientific use of marine environment	Educational and scientific research activities conducted in the intertidal or in the subtidal. Includes educational field trips to the shore (Seashore safaris) and research surveys (e.g. specimen/sediment sampling) conducted in the intertidal and/or subtidal (the latter conducted by divers, or via manned or unmanned (ROV) submersibles)	Vessel activity, educational and survey activities. Excludes anchoring and mooring pressures (see recreational boating and/or commercial shipping anchoring and mooring)

Table A2. Marine Habitat Assumptions

Activity	Activity Location Assumptions	Activity-Pressure Assumptions
Recreational boating – Participation	Activity does not occur in littoral habitats Activity may occur in any subtidal habitat, at any level of physical exposure	Abrasion/disturbance of seabed substrate surface may arise from engine/propeller wash in infralittoral habitats but not circalittoral habitats
Recreational boating – anchoring, mooring and launching	Launching may occur in eulittoral and infralittoral sediment habitats (gravel, coarse, sand, mixed but not mud) (rocky intertidal shores excluded) Anchoring/mooring may occur in any infralittoral or circalittoral habitat	Abrasion of substrate surface of seabed arises from launch of vessels in the intertidal and/or from anchoring or mooring in the subtidal Penetration/deep disturbance of substrate below the seabed surface arises from anchoring in the subtidal and will only be relevant in subtidal sedimentary habitats Physical change to another seabed (relating to moorings installed on the seabed) has been excluded from the assessment
Commercial shipping – vessel movements	Activity does not occur in littoral habitats Activity may occur in any subtidal habitat (at any level of physical exposure e.g. exposed, sheltered etc.) (although likely to be transiting through maintained navigation channels in estuaries) This activity has been considered to occur in all subtidal habitats (except fringe or shallow infralittoral habitats), however, for site specific assessments the depth of habitat and draft of commercial vessels will need to be considered further. A general assumption for site specific assessment could be that this activity may occur in water over 5 m depth	N/A
Commercial shipping – anchoring mooring	Activity only occurs in subtidal habitats (infralittoral or circalittoral) Activity may occur in any subtidal habitat (i.e. sedimentary or rocky)	Abrasion/disturbance to substrate on seabed surface arises from anchoring and mooring in the subtidal Penetration/deep disturbance of substrate below the seabed surface arises from anchoring in the subtidal and will only be relevant in subtidal sedimentary habitats Includes impact of any vessel lighting whilst anchored or moored (although introduction of light is not a relevant pressure for benthic habitats) Physical change to another seabed (relating to moorings installed on the seabed) has been excluded from the assessment
Personal watercraft (PWC)	Activity does not occur in littoral habitats Activity may occur in any subtidal habitat (at any level of physical exposure e.g. exposed, sheltered etc.)	None
Personal watercraft - launching	Launch of PWC may occur on littoral habitats and shallow sublittoral (infralittoral) habitats but not in circalittoral or supralittoral habitats	None

Activity	Activity Location Assumptions	Activity-Pressure Assumptions
	This activity may occur on any intertidal sedimentary habitats (except for mud/fine mud) but not on rocky habitats	
Hovercraft	Activity may occur in intertidal sediment habitats Activity may occur in any subtidal habitat (at any level of physical exposure e.g. exposed, sheltered etc.)	None
Tour boats	Activity does not occur in littoral habitats Activity may occur in any subtidal habitat (at any level of physical exposure e.g. exposed, sheltered etc.)	None
Kayaking	Activity does not occur in littoral habitats	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access
Paddleboarding	Activity does not occur in littoral habitats	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access
Surfing	Activity does not occur in littoral habitats	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access
Windsurfing and kite surfing	Activity does not occur in littoral habitats	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access
Dinghies_participation	Activity does not occur in littoral habitats	Excludes pressures arising from access (e.g. trampling) which covered under launch/recovery
Dinghies_ launching	Activity may occur in littoral habitats and shallow sublittoral (infralittoral) habitats but not in circalittoral or supralittoral habitats Activity may occur on any intertidal sedimentary habitats (except for mud/fine mud, biogenic or saltmarsh habitats) but not on rocky habitats	None
Non-motorised vehicles on the beach and foreshore	Activity may occur in littoral habitats but not in supralittoral or sublittoral habitats Activity may occur in intertidal sedimentary sand habitats but not muddy, gravel, shingle or rocky habitats	Excludes pressures arising from access to activity (e.g. trampling, if relevant) which covered under foot access
Walking (recreational)	Activity may occur on any intertidal sedimentary habitats (including sandy/gravelly mud but excluding mud/fine mud) or rocky habitats, but not in sublittoral habitats	Access to the activity and participation in the activity exert the same pressures
Foot access (to conduct activity)	Activity may occur on any intertidal or shallow subtidal habitat (including mud habitats e.g. relevant to bait digging activities)	None

Activity	Activity Location Assumptions	Activity-Pressure Assumptions
	Activity does not occur in deep subtidal (circalittoral) habitats	
Dog walking	Activity occurs in eulittoral habitats only Activity may occur on any intertidal sedimentary habitats (except mud/fine mud) or rocky habitats	Access to the activity and participation in the activity exert the same pressures
Horse riding	Activity may occur on sedimentary shores (sand/muddy sand but not mud/sandy mud or shingles) but not on rocky shores	Excludes pressures arising from access to activity (e.g. trampling, if relevant) which covered under foot access
Cycling	Activity likely to occur on littoral sand shores only	Excludes pressures arising from access to activity (e.g. trampling, if relevant) which covered under foot access
Coastal cliff climbing	This activity occurs above mean high water (i.e. not on the shore/intertidal)	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access Abrasion/disturbance of the substrate on the surface of the seabed is not a relevant pressure for coastal cliff climbing if this activity does not occur below mean high water (based on pressure definition)
Coasteering	Activity occurs in intertidal and shallow sublittoral (infralittoral) rocky habitats at any level of physical exposure	Access to the activity and participation in the activity exert the same pressures
Diving	Activity does not occur in littoral habitats (see pressure assumption) Activity may occur in any sublittoral habitat, at any level of physical exposure (although it is acknowledged that recreational diving is far more likely to occur in certain subtidal habitats than others, e.g. subtidal rocky habitats c.f. subtidal mobile sand habitats)	Excludes pressures arising from access (e.g. trampling, if diving from the shore) which covered under foot access
Snorkeling	Activity does not occur in littoral habitats (see pressure assumption) Activity may occur in any infralittoral habitat, except in sublittoral mud habitats, at any level of physical exposure (although it is acknowledged that snorkeling is more likely to occur in certain habitats than others, e.g. rocky habitats rather than sand habitats or estuaries) This activity does not occur over circalittoral habitats (rocky or sedimentary)	Excludes pressures arising from access (e.g. trampling) which covered under foot access.
Wildlife watching from shore	Wildlife watching from shore only occurs in eulittoral habitats, and may occur in any type of eulittoral habitat (e.g. sedimentary or rocky)	Excludes pressures arising from access (e.g. trampling) which covered under foot access. Abrasion/disturbance of the substrate on the surface of the seabed, arising from this activity, is only relevant in eulittoral habitats (not supralittoral (due to definition of pressure) or sublittoral (due to definition of activity))

Activity	Activity Location Assumptions	Activity-Pressure Assumptions
General beach leisure	Activity occurs in littoral and shallow subtidal (infralittoral) habitats but not circalittoral habitats Activity may occur in any eulittoral and infralittoral habitat (i.e. rocky or sedimentary) except for mud habitats	Abrasion/disturbance of the substrate on the surface of the seabed is a relevant pressure in eulittoral and infralittoral habitats (but not supralittoral habitats due to definition of pressure (i.e. affecting seabed)) Litter and Penetration and/or disturbance of the substrate below the surface of the seabed (including abrasion) arising from beach leisure are relevant pressure to eulittoral habitats but not infralittoral habitats (e.g. littering, digging in sand etc. may occur in the intertidal but not shallow subtidal). Although a relevant pressure arising from this activity, there are no existing sensitivity assessments for pressures arising from littering (all assigned 'NA' = Not Assessed)
Light aircraft - motorised	Motorised light aircraft take off from, and land to, official airfields Aerial activity may occur over any eulittoral or sublittoral habitat	None
Light aircraft – non- motorised	Non-motorised light aircraft do not take off from, or land on, intertidal habitats Aerial activity may occur over any eulittoral or sublittoral habitat	None
Jet aircraft	Jet aircraft take off from and land to official airfields/airports Aerial activity may occur over any eulittoral or sublittoral habitat	None
Use of drones	Drone use (operated from the shore) may occur over any eulittoral or shallow sublittoral (infralittoral) habitat	Excludes pressures arising from access to activity (e.g. trampling, if relevant) which covered under foot access
Angling from shore	Activity occurs in shallow sublittoral (infralittoral) habitats but not circalittoral habitats Activity removal of species phase) may occur in any infralittoral habitat Activity does not include removal/harvesting of non-target species in eulittoral habitats for use as bait (see bait digging)	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access Litter is a pressure that may be exerted in any eulittoral or infralittoral habitat through lost or discarded angling gear The sensitivity to 'removal of target species' would only be relevant where the target species is a key characterising species of the biotope. As such, the sensitivity assessments for this pressure were not considered relevant to this activity-pressure as none of the biotopes are characterised by the presence of species targeted by anglers
Angling from vessel	Activity does not occur in eulittoral habitats. Activity may occur in any sublittoral habitats (regardless of the level of physical exposure)	Litter is a pressure that may be exerted in any subtidal habitat (e.g. via lost gear/line) The sensitivity to 'removal of target species' would only be relevant where the target species is a key characterising species of the biotope.

Activity	Activity Location Assumptions	Activity-Pressure Assumptions
		As such, the sensitivity assessments for this pressure were not considered relevant to this activity-pressure as none of the biotopes are characterised by the presence of species targeted by anglers
Bait digging and collection – digging	Activity may occur in eulittoral sedimentary habitats but not supralittoral or sublittoral habitats Activity may occur in eulittoral sand/sandy mud/muddy sand and mud biotopes. Activity was not considered likely to occur on shingle, coarse sediment, barren sediment or gravel	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access
Bait digging and collection – tiles / tubes	Activity may occur in eulittoral sedimentary habitats but not in supralittoral or sublittoral habitats Activity may occur on eulittoral sandy or muddy intertidal sediments. Activity was not considered likely to occur on shingle, coarse sediment, barren sediment or gravel	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access Litter was considered to be a relevant pressure arising from this activity due to the placement of tiles/pipes/tyres etc. on the intertidal Removal of target species was only considered to be a relevant pressure if the target species (shore crab, *Carcinus maenas*) was being targeted in a biotope for which they were a characterising species of the biotope
Bait digging and collection – boulder turning	Activity occurs in eulittoral habitats but not in supralittoral or sublittoral habitats Activity may occur on rocky or sediment habitats where boulders/cobbles etc. are likely to occur Activity was not considered likely to occur on sedimentary habitats such as shingle, sand, mud or gravel shores	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access Removal of target species was only considered to be a relevant pressure if the target species (shore crab, *Carcinus maenas* or winkles) were being targeted in a biotope for which they were a characterising species of the biotope. Visual disturbance is not a relevant pressure for benthic habitats
Collection of shellfish (hand gathering)	Activity may occur in eulittoral rocky or sedimentary habitats (related to the target species' habitats) but not in supralittoral or sublittoral habitats	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access Removal of target species is only considered to be a relevant pressure if the shellfish being targeted by this activity is a key characterising species of the biotope (only the case for cockles, mussels and periwinkles)
Collection of shellfish (using tools)	Activity may occur in eulittoral rocky or sedimentary habitats (related to the target species' habitats) but not in supralittoral or sublittoral habitats	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access Removal of target species is only considered to be a relevant pressure if the shellfish being targeted by this activity is a key characterising species of the biotope (only the case for cockles and mussels)
Netting	Activity may occur in shallow sublittoral (infralittoral) habitats but not circalittoral habitats	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access

Activity	Activity Location Assumptions	Activity-Pressure Assumptions
	Activity may occur in any infralittoral sedimentary habitat but not likely to occur in infralittoral rocky habitats (including biogenic reefs)	Abrasion of the substrate surface (subtidally) was considered a relevant pressure arising from setting and hauling of nets Removal of target or non-target species would only be considered relevant pressures if the species caught were the characterising species of a biotope
Hobby potting	Activity may occur in any rocky or sedimentary subtidal habitat, except subtidal mud/fine mud/sandy mud habitats.	Removal of target species and non-target species would only be considered relevant pressures if the species being removed by this activity were key characterising species of a biotope
Collection of Salicornia / samphire	Activity occurs in saltmarsh habitats only	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access. However, within saltmarsh habitats, collection and access are considered to exert the same pressures
Acoustic surveys	Activity does not occur in eulittoral habitats Activity may occur in any sedimentary or rocky subtidal habitat	None
Education / scientific use of marine environment	Activity may occur on any supralittoral, intertidal or subtidal habitats (sedimentary or rocky)	Excludes pressures arising from access to activity (e.g. trampling) which covered under foot access Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion (as defined) is not a relevant pressure in rocky habitats (littoral or sublittoral) Sensitivity of habitats to the removal of target and non-target species have been included, however, the relevance of the sensitivity scores to the activity will depend on the species targeted by the activity (not known for this activity) hence it should be noted that this assessment may not accurately reflect the sensitivity of the habitats to the activity. Where the highest sensitivity scores have been based on the sensitivity to the removal of a target or non-target species, these have been highlighted in yellow

Table A3. Mobile features - assumptions

Mobile Feature	**Assumption**
Otter	Not expected to be exposed to collision with vessels.
Birds	Activities undertaken on land/intertidal such as beaches are not considered to impact on birds that are rarely recorded foraging within very close proximity to shore (i.e. Red-throated diver, Puffin, Gannet, Manx Shearwater, Storm Petrol, Common Scoter). Other diving birds considered to have the potential to be recorded in coastal areas near the shore (as well as further offshore). All other birds (dabbling ducks, geese and waders) considered to be coastal species which feed within (or nearby to intertidal).
Birds	Activities which could be undertaken near cliffs (such a walking on footpaths, coasteering, climbing) have the potential to cause visual disturbance to cliff nesting birds (i.e. to Puffin, Manx Shearwater, Storm Petrol, Gannet). No risk to other birds including Gannet (only nests on Grassholm within Wales which is inaccessible to public). Note: As Gannet assumption above was site specific now we are using same assumption for other nesting seabirds above.
Birds	Activities undertaken on rocky coasts not considered to impact bird species occurring along sediment coastal habitats.

Appendix B: Pressure Definitions

Table B1. Pressure definitions

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
Abrasion/disturbance of the substrate on the surface of the seabed	Benthic species /habitats	Damage to surface features (e.g. species and physical structures within the habitat)	Physical disturbance or abrasion at the surface of the substratum in sedimentary or rocky habitats. The effects are relevant to epiflora and epifauna living on the surface of the substratum. In intertidal and sublittoral fringe habitats, surface abrasion is likely to result from recreational access and trampling (inc. climbing) by human or livestock, vehicular access, moorings (ropes, chains), activities that increase scour and grounding of vessels (deliberate or accidental). In the sublittoral, surface abrasion is likely to result from pots or creels, cables and chains associated with fixed gears and moorings, anchoring of recreational vessels, objects placed on the seabed such as the legs of jack-up barges, and harvesting of seaweeds (e.g. kelps) or other intertidal species (trampling) or of epifaunal species (e.g. oysters). In sublittoral habitats, passing bottom gear (e.g. rock hopper gear) may also cause surface abrasion to epifaunal and epifloral communities, including epifaunal biogenic reef communities. Activities associated with surface abrasion can cover relatively large spatial areas e.g. bottom trawls or bio-prospecting or be relatively localized activities e.g. seaweed harvesting, recreation, potting, and aquaculture.	None
Barrier to species movement	Benthic species	Permanent or temporary barrier to species movement over ≥50% of water body width or a 10% change in tidal excursion	The physical obstruction of species movements and including local movements (within and between roosting, breeding, feeding areas) and regional/global migrations (e.g. birds, eels, salmon, and whales). Both include up-river movements (where tidal barrages and devices or dams could obstruct movements) or movements across open waters (offshore wind farm, wave or tidal device arrays, mariculture infrastructure or fixed fishing gears). Species affected are mostly highly mobile birds, fish, and mammals.	The pressure is clearly relevant to mobile species such as fish, birds, reptiles and mammals. However, it should also be considered relevant to species or macrofauna such as crabs that undertake migrations to over-winter or to breed, and where populations are dependent on larval or other propagule supply from outside the site.
Changes in suspended solids (water clarity)		A change in one rank on the WFD (Water Framework Directive) scale e.g. from clear to intermediate for one year.	Changes water clarity (or turbidity) due to changes in sediment and organic particulate matter and chemical concentrations. It is related to activities disturbing sediment and/or organic particulate matter and mobilizing it into the water column. It could be 'natural' land run-off and riverine discharges or from anthropogenic activities such as all forms of dredging, disposal at sea, cable and pipeline burial, secondary effects of construction works, e.g. breakwaters. Particle size, hydrological energy (current speed and direction) and tidal excursion are all influencing factors on the spatial extent and temporal duration. Salinity, turbulence, pH and temperature may result in flocculation of suspended organic matter. Anthropogenic	None

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
			sources are mostly short lived and over relatively small spatial extents. Changes in suspended sediment loads can also alter the scour experienced by species and habitats. Therefore, the effects of scour are also addressed here.	
Collision BELOW water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures)	Benthic species	0.1% of tidal volume on an average tide, passing through artificial structure	Injury or mortality from collisions of biota with both static and/or moving structures. Examples include collision with rigs (e.g. birds) or screens in intake pipes (e.g. fish at power stations) (static) or collisions with wind turbine blades, fish and mammal collisions with tidal devices and shipping (moving). Activities increasing the number of vessels transiting areas, e.g. new port development or construction works will influence the scale and intensity of this pressure.	The benthic species benchmark is only relevant to larvae. Collision with benthic habitats due to grounding by vessels is addressed under 'abrasion'.
Deoxygenation		Exposure to dissolved oxygen concentration of less than or equal to 2 mg/l for 1 week (a change from WFD poor status to bad status).	Any deoxygenation that is not directly associated with nutrient or organic enrichment. The lowering, temporarily or more permanently, of oxygen levels in the water or substrate due to anthropogenic causes (some areas may naturally be deoxygenated due to stagnation of water masses, e.g. inner basins of fjords). This is typically associated with nutrient and organic enrichment, but it can also derive from the release of ballast water or other stagnant waters (where organic or nutrient enrichment may be absent). Ballast waters may be deliberately deoxygenated via treatment with inert gases to kill non-indigenous species.	There is considerable evidence on the effects on de-oxygenation in the marine environment due to ongoing work and reviews by Diaz & Rosenberg among others. Therefore, we suggest a return to the MarLIN benchmark of a reduction in oxygen to ≤2 mg/l for one week. The proposed benchmark would be based on the WFD status of 'poor' to 'bad' in marine waters and the 'action levels' for transitional waters (UKTAG, 2014).
Electromagnetic changes		Local electric field of 1 V/m. Local magnetic field of 10 μT	Localized electric and magnetic fields associated with operational power cables and telecommunication cables (if equipped with power relays). Such cables may generate electric and magnetic fields that could alter behaviour and migration patterns of sensitive species (e.g. sharks and rays).	The evidence to assess these effects against the pressure benchmark is very limited and the impact of this pressure could not be assessed for benthic species or habitats (Tillin & Tyler-Walters, 2014).
Emergence regime changes, including tidal level change considerations		A change in the time covered or not covered by the sea for a period of ≥ 1 year Or An increase in relative sea level or decrease in high water level for ≥ 1 year.	Changes in water levels reducing the intertidal zone (and the associated/dependent habitats). The pressure relates to changes in both the spatial area and duration that intertidal species are immersed and exposed during tidal cycles (the percentage of immersion is dependent on the position or height on the shore relative to the tide). The spatial and temporal extent of the pressure will be dependent on the causal activities but can be delineated. This relates to anthropogenic causes that may directly influence the temporal and spatial extent of tidal immersion, e.g. upstream and downstream of a tidal barrage the emergence would be respectively reduced and increased, beach re-profiling could change gradients and therefore exposure times, capital dredging may change the natural tidal range, managed realignment, salt marsh creation. Such alteration may be of importance in estuaries because of their	The benchmark is only relevant to the intertidal, excluding habitats below Chart Datum (CD). The pressure benchmark does not expressly identify the role of 'desiccation' but sensitivity to desiccation will be discussed where known or relevant. In application, the majority of intertidal communities are sensitive to changes in emergence, whether it is for one or more hours, or a due to changes in sea level and coastal squeeze. The duration assumes that the effects on most communities would probably take a year to become apparent.

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
			influence on tidal flushing and potential wave propagation. Changes in tidal flushing can change the sediment dynamics and may lead to changing patterns of deposition and erosion. Changes in tidal levels will only affect the emergence regime in areas that are inundated for only part of the time. The effects that tidal level changes may have on sediment transport are not restricted to these areas, so a very large construction could significantly affect the tidal level at a deep site without changing the emergence regime. Such a change could still have a serious impact. This excludes pressure from sea level rise.	
Genetic modification and translocation of indigenous species	Benthic species / habitats / Fish	Translocation of indigenous species and/or introduction of genetically modified or genetically different populations of indigenous species that may result in changes in genetic structure of local populations, hybridization, or change in community structure.	Genetic modification can be either deliberate (e.g. introduction of farmed individuals to the wild, GM food production) or a by-product of other activities (e.g. mutations associated with radionuclide contamination). Former related to escapees or deliberate releases e.g. cultivated species such as farmed salmon, oysters, scallops if GM practices employed. The scale of pressure compounded if GM species "captured" and translocated in ballast water. Mutated organisms from the latter could be transferred on ships hulls, in ballast water, with imports for aquaculture, aquaria, live bait, species traded as live seafood or 'natural' migration.	Genetic modification can be either deliberate (e.g. introduction of farmed individuals to the wild, GM food production) or a by-product of other activities (e.g. mutations associated with radionuclide contamination). The former is related to escapees or deliberate releases e.g. cultivated species such as farmed salmon, oysters, and scallops if GM practices or breeding programmes are employed. The scale of pressure is compounded if GM species "captured" and translocated in ballast water. GM species could be transferred on ships hulls, in ballast water, with imports for aquaculture, aquaria, live bait, species traded as live seafood or 'natural' migration. The pressure also relates to the translocation of indigenous species which may compete with local populations of species, alter the community of the receiving habitat, or provide the opportunity for hybridization between similar species (e.g. *Spartina* spp. and *Mytilus* spp.).
Habitat structure changes - removal of substratum (extraction)		Extraction of substratum to 30 cm (where substratum includes sediments and soft rocks but excludes hard bedrock)	Unlike the "physical change" pressure type where there is a permanent change in sea bed type (e.g. sand to gravel, sediment to a hard artificial substratum) the "habitat structure change" pressure type relates to temporary and/or reversible change, e.g. from marine mineral extraction where a proportion of seabed sands or gravels are removed but a residual layer of seabed is similar to the pre-dredge structure and as such biological communities could re-colonize; navigation dredging to maintain channels where the silts or sands removed are replaced by non-anthropogenic mechanisms so the sediment typology is not changed.	None
Hydrocarbon and PAH contamination. Includes those priority substances		Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls	Increases in the levels of these compounds compared with background concentrations. Naturally occurring compounds, complex mixtures of two basic molecular structures:- straight chained aliphatic hydrocarbons (relatively low toxicity and susceptible to degradation)- multiple ringed aromatic	None

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
listed in Annex II of Directive 2008/105/EC.			hydrocarbons (higher toxicity and more resistant to degradation). These fall into three categories based on source (includes both aliphatics and polyaromatic hydrocarbons):- petroleum hydrocarbons (from natural seeps, oil spills and surface water run-off)- pyrogenic hydrocarbons (from combustion of coal, woods and petroleum)- biogenic hydrocarbons (from plants and animals) Ecological consequences include tainting, some are acutely toxic, carcinomas, growth defects.	
Introduction of light		Change in incident light via anthropogenic means.	Direct inputs of light from anthropogenic activities, i.e. lighting on structures during construction or operation to allow 24 hour working; new tourist facilities, e.g. promenade or pier lighting, lighting on oil and gas facilities etc. Ecological effects may be the diversion of bird species from migration routes if they are disorientated by or attracted to the lights. It is also possible that continuous lighting may lead to increased algal growth.	The introduction of light is unlikely to be relevant for most benthic invertebrates, except where it is possible to interfere with spawning cues. But we are not aware of evidence to that effect. The introduction of light could potentially be beneficial for immersed plants, but again, we are not aware of any relevant evidence. Alternatively, shading (e.g. due to overgrowth, construction of jetties or other artificial structures) could adversely affect shallow sublittoral macroalgae, seagrass, and pondweeds.
Introduction of microbial pathogens	Benthic species / habitats / Fish / Birds / Mammals	The introduction of relevant microbial pathogens or metazoan disease vectors to an area where they are currently not present (e.g. *Martelia refringens* and *Bonamia*, Avian influenza virus, viral Haemorrhagic Septicaemia virus).	Untreated or insufficiently treated effluent discharges and run-off from terrestrial sources and vessels. It may also be a consequence of ballast water releases. In mussel or shellfisheries where seed stock is imported, 'infected' seed could be introduced, or it could be from accidental releases of effluvia. Escapees e.g. farmed salmon could be infected and spread pathogens in the indigenous populations. Aquaculture could release contaminated faecal matter, from which pathogens could enter the food chain.	Any significant pathogens or disease vectors relevant to species or the species that characterize biotopes/ habitats identified during the evidence review phase will be noted in the review text.
Introduction of other substances (solid, liquid or gas)		Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls	The 'systematic or intentional release of liquids, gases ' (from MSFD Annex III Table 2) is considered e.g. in relation to produced water from the oil industry. It should, therefore, be considered in parallel with the other chemical contaminants below.	None
Introduction or spread of invasive non-indigenous species (INIS)		The introduction of one or more invasive non-indigenous species (INIS)	The direct or indirect introduction of invasive non-indigenous species, e.g. Chinese mitten crabs, slipper limpets, Pacific oyster and their subsequent spreading and out-competing of native species. Ballast water, hull fouling, stepping stone effects (e.g. offshore wind farms) may facilitate the spread of such species. This pressure could be associated with aquaculture, mussel or shellfishery activities due to imported seed stock or from accidental releases.	Sensitivity assessment will be made against a prescribed list of INIS based on the GBNNSIP list of potentially invasive species.

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
Litter	Benthic species/habitat	Introduction of man-made objects able to cause physical harm (surface, water column, sea floor and/or strandline)	Marine litter is any manufactured or processed solid material from anthropogenic activities discarded, disposed or abandoned (excluding legitimate disposal) once it enters the marine and coastal environment including plastics, metals, timber, rope, fishing gear etc. and their degraded components, e.g. microplastic particles. Ecological effects can be physical (smothering), biological (ingestion, including uptake of microplastics; entangling; physical damage; accumulation of chemicals) and/or chemical (leaching, contamination). We are not aware of any evidence on the effects of 'litter' on benthic marine species. While there is documented evidence of the accumulation of microplastics in some species, no ecological effects have been shown to date. The only exception is the effect of ghost fishing on large crustaceans (crabs etc.). Therefore, the sensitivity to litter was not assessed for habitats and was scored 'No evidence' by Tillin & Tyler-Walters (2014). Clearly, it is relevant for large macrofauna such as fish, birds and mammals.	None
Nutrient enrichment		Compliance with WFD criteria for good status	Increased levels of the elements nitrogen, phosphorus, silicon (and iron) in the marine environment compared to background concentrations. Nutrients can enter marine waters by natural processes (e.g. decomposition of detritus, riverine, direct and atmospheric inputs) or anthropogenic sources (e.g. waste water runoff, terrestrial/agricultural runoff, sewage discharges, aquaculture, atmospheric deposition). Nutrients can also enter marine regions from 'upstream' locations, e.g. via tidal currents to induce enrichment in the receiving area. Nutrient enrichment may lead to eutrophication (see also organic enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.	None
Organic enrichment		A deposit of 100 gC/m²/yr	Resulting from the degraded remains of dead biota and microbiota (land and sea); faecal matter from marine animals; flocculated colloidal organic matter and the degraded remains of: sewage material, domestic wastes, industrial wastes etc. Organic matter can enter marine waters from sewage discharges, aquaculture or terrestrial/agricultural runoff. Black carbon comes from the products of incomplete combustion (PIC) of fossil fuels and vegetation. Organic enrichment may lead to eutrophication (see also nutrient enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.	Direct evidence on the effect of organic enrichment was used to make sensitivity assessments by Tillin & Tyler-Walters (2014). In the absence of direct evidence, reference was made to the AMBI index, supplemented by any other relevant evidence on the effects of organic enrichment on habitats.

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Benthic species /habitats	Damage to sub-surface features (e.g. species and physical structures within the habitat)	Physical disturbance of sediments where there is limited or no loss of substratum from the system. This pressure is associated with activities such as anchoring, taking of sediment/geological cores, cone penetration tests, cable burial (ploughing or jetting), propeller wash from vessels, certain fishing activities, e.g. scallop dredging, beam trawling. Agitation dredging, where sediments are deliberately disturbed by and by gravity and hydraulic dredging where sediments are deliberately disturbed and moved by currents could also be associated with this pressure type. Compression of sediments, e.g. from the legs of a jack-up barge could also fit into this pressure type. Abrasion relates to the damage of the sea bed surface layers (typically up to 50 cm depth). Activities associated with abrasion can cover relatively large spatial areas and include fishing with towed demersal trawls (fish and shellfish); bio-prospecting such as harvesting of biogenic features such as maerl beds where, after extraction, conditions for recolonization remain suitable or relatively localised activities including seaweed harvesting, recreation, potting, aquaculture. Change from gravel to silt substrata would adversely affect herring spawning grounds. Loss, removal or modification of the substratum is not included within this pressure (see the physical loss pressure theme). Penetration and damage to the soft rock substrata are considered, however, penetration into hard bedrock is deemed unlikely.	None
Physical change (to another seabed type)		2) Change from sedimentary or soft rock substrata to hard rock or artificial substrata or vice-versa.	The permanent change of one marine habitat type to another marine habitat type, through the change in the substratum, including to artificial (e.g. concrete). This, therefore, involves the permanent loss of one marine habitat type but has an equal creation of a different marine habitat type. Associated activities include the installation of infrastructure (e.g. surface of platforms or wind farm foundations, marinas, coastal defences, pipelines and cables), the placement of scour protection where soft sediment habitats are replaced by hard/coarse substratum habitats, removal of coarse substrata (marine mineral extraction) in those instances where surficial finer sediments are lost, capital dredging where the residual sedimentary habitat differs structurally from the pre-dredge state, creation of artificial reefs, mariculture i.e. mussel beds. Protection of pipes and cables using rock dumping and mattressing techniques. Placement of cuttings piles from oil and gas activities could fit this pressure type, however, there may be additional pressures, e.g. "pollution and other chemical changes" theme.	Tillin & Tyler-Walters (2014) did not consider the change in one Folk class benchmark applicable to hard rock biotopes but did assess the sensitivity of biotopes occurring on softer substrata, including chalk, peat, mud rock, and clay. The simplified Folk class referred to in the benchmark is based on the simplified classification used for UK SeaMap as described by Long (2006).A change from sediment to hard rock (or *vice versa*) would affect all types of substratum, and all habitats would be assessed as highly sensitive. This pressure assumes a permanent change, while short-term smothering of substrata with sediment is addressed under smothering (siltation).

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
			This pressure excludes navigation dredging where the depth of sediment is changed locally but the sediment typology is not changed.	
Physical change (to another sediment type)	Benthic species/habitat	1) Change in sediment type by one Folk class (based on UK SeaMap simplified classification).	The permanent change of one marine habitat type to another marine habitat type, through the change in the substratum, including to artificial (e.g. concrete). This, therefore, involves the permanent loss of one marine habitat type but has an equal creation of a different marine habitat type. Associated activities include the installation of infrastructure (e.g. surface of platforms or wind farm foundations, marinas, coastal defences, pipelines and cables), the placement of scour protection where soft sediment habitats are replaced by hard/coarse substratum habitats, removal of coarse substrata (marine mineral extraction) in those instances where surficial finer sediments are lost, capital dredging where the residual sedimentary habitat differs structurally from the pre-dredge state, creation of artificial reefs, mariculture i.e. mussel beds. Protection of pipes and cables using rock dumping and mattressing techniques. Placement of cuttings piles from oil and gas activities could fit this pressure type, however, there may be additional pressures, e.g. "pollution and other chemical changes" theme. This pressure excludes navigation dredging where the depth of sediment is changed locally but the sediment typology is not changed.	Tillin & Tyler-Walters (2014) did not consider the change in one Folk class benchmark applicable to hard rock biotopes but did assess the sensitivity of biotopes occurring on softer substrata, including chalk, peat, mud rock, and clay. The simplified Folk class referred to in the benchmark is based on the simplified classification used for UK SeaMap as described by Long (2006). A change from sediment to hard rock (or *vice versa*) would affect all types of substratum, and all habitats would be assessed as highly sensitive. This pressure assumes a permanent change, while short-term smothering of substrata with sediment is addressed under smothering (siltation).
Physical loss (to land or freshwater habitat)		Permanent loss of existing saline habitat within site	The permanent loss of marine habitats. Associated activities are land claim, new coastal defences that encroach on and move the Mean High Water Springs mark seawards, the footprint of a wind turbine on the seabed, dredging if it alters the position of the halocline. This excludes changes from one marine habitat type to another marine habitat type.	None
Radionuclide contamination		An increase in 10 µGy/h above background levels	Introduction of radionuclide material, raising levels above background concentrations. Such materials can come from nuclear installation discharges, and from land or sea-based operations (e.g. oil platforms, medical sources). The disposal of radioactive material at sea is prohibited unless it fulfils exemption criteria developed by the International Atomic Energy Agency (IAEA), namely that both the following radiological criteria are satisfied: (i) the effective dose expected to be incurred by any member of the public or ship's crew is 10 µSv or less in a year; (ii) the collective effective dose to the public or ship's crew is not more than 1 man Sv per annum, then the material is deemed to contain *de minimis* levels of radioactivity and may be disposed at sea pursuant to it fulfilling all the other provisions under the Convention. The individual dose criteria are	None

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
			placed in perspective (i.e. very low), given that the average background dose to the UK population is ~2700 µSv/a. Ports and coastal sediments can be affected by the authorised discharge of both current and historical low-level radioactive wastes from coastal nuclear establishments.	
Removal of non-target species		Removal of features or incidental non-targeted catch (by-catch) through targeted fishery, shellfishery or harvesting at a commercial or recreational scale.	By-catch associated with all fishing, harvesting and extraction activities. Ecological consequences include food web dependencies, population dynamics of fish, marine mammals, turtles and sea birds (including survival threats in extreme cases, e.g. Harbour Porpoise in Central and Eastern Baltic). The physical effects of fishing gear on sea bed communities are addressed by the "abrasion" pressure type so the pressure addresses the direct removal of individuals associated with fishing/ harvesting.	This pressure addresses only the ecological effects of removal of species and not the effects of the removal process on the species, community or habitat itself, which results in confusion. Food-web impacts are only relevant to higher trophic levels (birds, fish, mammals and turtles): for benthic habitats and associated species, the pressure has been interpreted as specifically referring to the risk of ecological effects arising from the removal of species that are not directly targeted by fisheries. The assessment considers whether species present in the biotope are likely to be damaged or removed by relevant activities and whether this removal is likely to result in measurable effects on biotope classification, structure (in terms of both biological structure e.g. species richness and diversity and the physical structure, sometimes referred to as habitat complexity) and function. Examples of biotopes that are sensitive to this pressure are therefore i) biogenic habitats that are created by species which may be removed by fishing activities, e.g. maerl beds and hard substrata that are dominated by plant and animal assemblages, ii) biotopes characterized by ecosystem engineers or keystone species that strongly determine the rate of some ecological processes, e.g. beds of suspension feeders that cycle nutrients between the water column and substratum and iii) biotopes with key characterizing species, (e.g. those named in the biotope description or identified as important by the biotope description) that are likely to be removed or displaced as by-catch.
Removal of target species		Removal of species targeted by fishery, shellfishery or harvesting at a commercial or recreational scale.	The commercial exploitation of fish and shellfish stocks, including smaller scale harvesting, angling and scientific sampling. The physical effects of fishing gear on sea bed communities are addressed by the "abrasion" pressures above. This pressure addresses the direct removal/harvesting of biota. Ecological consequences include the sustainability of stocks, impacting energy flows through food webs and the size and age composition within fish stocks.	This pressure addresses only the ecological effects of removal of species and not the effects of the removal process on the species, community or habitat itself. Food-web impacts are only relevant to higher trophic levels (birds, fish, mammals and turtles): for benthic habitats and associated species, the pressure has been interpreted as specifically referring to the risk of ecological effects arising from the removal of species that are directly targeted. The assessment considers whether species present in the biotope are likely to be directly targeted and whether this removal is likely to result in measurable effects on biotope classification, structure (in terms of both biological structure e.g. species richness and diversity and the physical structure, sometimes referred to as habitat complexity) and function. Examples of biotopes that are sensitive to this pressure

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
				are therefore i) biogenic habitats that are created by species which may be directly targeted, e.g. bivalve beds, kelp beds, *Ostrea edulis* reefs ii) biotopes characterized by ecosystem engineers or keystone species that strongly determine the rate of some ecological processes and that are directly targeted, e.g. *Echinus esculentus* as keystone grazers maintaining urchin barrens, and *Arenicola marina* which are key bioturbators that may be collected for bait, and iii) biotopes with key characterizing species, (e.g. those named in the biotope description or identified as important by the biotope description) that are likely to be removed as target species, e.g. collection of piddocks for bait or food from biotopes defined on the presence of piddocks.
Salinity decrease		A decrease or an increase in one MNCR salinity category outside the usual range of the biotope/habitat for one year. http://www.marlin.ac.uk/glossary/salinity	Events or activities increasing or decreasing local salinity. This relates to anthropogenic sources/causes that have the potential to be controlled, e.g. freshwater discharges from pipelines that reduce salinity, or brine discharges from salt caverns washings that may increase salinity. This could also include hydromorphological modification, e.g. capital navigation dredging if this alters the halocline or erection of barrages or weirs that alter freshwater/seawater flow/exchange rates. The pressure may be temporally and spatially delineated derived from the causal event/activity and local environment.	None
Salinity increase		A decrease or an increase in one MNCR salinity category outside the usual range of the biotope/habitat for one year. http://www.marlin.ac.uk/glossary/salinity	Events or activities increasing or decreasing local salinity. This relates to anthropogenic sources/causes that have the potential to be controlled, e.g. freshwater discharges from pipelines that reduce salinity, or brine discharges from salt caverns washings that may increase salinity. This could also include hydromorphological modification, e.g. capital navigation dredging if this alters the halocline or erection of barrages or weirs that alter freshwater/seawater flow/exchange rates. The pressure may be temporally and spatially delineated derived from the causal event/activity and local environment.	None
Smothering and siltation rate changes (Heavy)		‘Heavy’ deposition of up to 30 cm of fine material added to the habitat in a single discrete event	When the natural rates of siltation are altered (increased or decreased). Siltation (or sedimentation) is the settling out of silt/sediments suspended in the water column. Activities associated with this pressure type include mariculture, land claim, navigation dredging, disposal at sea, marine mineral extraction, cable and pipeline laying and various construction activities. It can result in short-lived sediment concentration gradients and the accumulation of sediments on the sea floor. This accumulation of sediments is synonymous with "light"	None

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
			smothering, which relates to the depth of vertical overburden. “Light” smothering relates to the deposition of layers of sediment on the seabed. It is associated with activities such as sea disposal of dredged materials where sediments are deliberately deposited on the sea bed. For “light” smothering most benthic biota may be able to adapt, i.e. vertically migrate through the deposited sediment. “Heavy” smothering also relates to the deposition of layers of sediment on the seabed but is associated with activities such as sea disposal of dredged materials where sediments are deliberately deposited on the sea bed. This accumulation of sediments relates to the depth of vertical overburden where the sediment type of the existing and deposited sediment has similar physical characteristics because, although most species of marine biota are unable to adapt, e.g. sessile organisms unable to make their way to the surface, a similar biota could, with time, re-establish. If the sediments were physically different this would fall under L2.	
Smothering and siltation rate changes (Light)	Benthic species/habitat	‘Light’ deposition of up to 5 cm of fine material added to the habitat in a single, discrete event	When the natural rates of siltation are altered (increased or decreased). Siltation (or sedimentation) is the settling out of silt/sediments suspended in the water column. Activities associated with this pressure type include mariculture, land claim, navigation dredging, disposal at sea, marine mineral extraction, cable and pipeline laying and various construction activities. It can result in short-lived sediment concentration gradients and the accumulation of sediments on the sea floor. This accumulation of sediments is synonymous with "light" smothering, which relates to the depth of vertical overburden. “Light” smothering relates to the deposition of layers of sediment on the seabed. It is associated with activities such as sea disposal of dredged materials where sediments are deliberately deposited on the sea bed. For “light” smothering most benthic biota may be able to adapt, i.e. vertically migrate through the deposited sediment. “Heavy” smothering also relates to the deposition of layers of sediment on the seabed but is associated with activities such as sea disposal of dredged materials where sediments are deliberately deposited on the sea bed. This accumulation of sediments relates to the depth of vertical overburden where the sediment type of the existing and deposited sediment has similar physical characteristics because, although most species of marine biota are unable to adapt, e.g. sessile organisms unable to make their way to the surface, a similar biota could, with time, re-establish. If the sediments were physically different this would fall under L2.	None

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Includes those priority substances listed in Annex II of Directive 2008/105/EC.		Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls	Increases in the levels of these compounds compared with background concentrations. Synthesised from a variety of industrial processes and commercial applications. Chlorinated compounds include polychlorinated biphenols (PCBs), dichlor-diphenyl-trichloroethane (DDT) and 2,3,7,8-tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD) are persistent and often very toxic. Pesticides vary greatly in structure, composition, environmental persistence and toxicity to non-target organisms. Includes insecticides, herbicides, rodenticides and fungicides. Pharmaceuticals and Personal Care Products originate from veterinary and human applications compiling a variety of products including, Over the counter medications, fungicides, chemotherapy drugs and animal therapeutics, such as growth hormones. Due to their biologically active nature, high levels of consumption, known combined effects, and their detection in most aquatic environments they have become an emerging concern. Ecological consequences include physiological changes (e.g. growth defects, carcinomas).	None
Temperature decrease		A decrease or an increase in 5°C for one month, or 2°C for one year.	Events or activities increasing or decreasing local water temperature. This is most likely from thermal discharges, e.g. the release of cooling waters from power stations. This could also relate to temperature changes in the vicinity of operational sub-sea power cables. This pressure only applies within the thermal plume generated by the pressure source. It excludes temperature changes from global warming which will be at a regional scale (and as such are addressed under the climate change pressures).	None
Temperature increase		A decrease or an increase in 5°C for one month, or 2°C for one year.	Events or activities increasing or decreasing local water temperature. This is most likely from thermal discharges, e.g. the release of cooling waters from power stations. This could also relate to temperature changes in the vicinity of operational sub-sea power cables. This pressure only applies within the thermal plume generated by the pressure source. It excludes temperature changes from global warming which will be at a regional scale (and as such are addressed under the climate change pressures).	None
Transition elements and organo-metal (e.g. TBT) contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.		Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls	The increase in transition elements levels compared with background concentrations, due to their input from land/riverine sources, by air or directly at sea. For marine sediments the main elements of concern are Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead and Zinc Organo-metallic compounds such as the butyl tins (Tri butyl tin and its derivatives) can be	None

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
			highly persistent and chronic exposure to low levels has adverse biological effects, e.g. Imposex in molluscs.	
Underwater noise changes	Benthic species/habitat	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year	Increases over and above background noise levels (consisting of environmental noise (ambient) and incidental man-made/anthropogenic noise (apparent)) at a particular location. Species known to be affected are marine mammals and fish. The theoretical zones of noise influence (Richardson *et al* 1995) are temporary or permanent hearing loss, discomfort and injury; response; masking and detection. In extreme cases, noise pressures may lead to death. The physical or behavioural effects are dependent on a number of variables, including the sound pressure, loudness, sound exposure level and frequency. High amplitude low and mid-frequency impulsive sounds and low frequency continuous sound are of greatest concern for effects on marine mammals and fish. Some species may be responsive to the associated particle motion rather than the usual concept of noise. Noise propagation can be over large distances (tens of kilometres) but transmission losses can be attributable to factors such as water depth and sea bed topography. Noise levels associated with construction activities, such as pile-driving, are typically significantly greater than operational phases (i.e. shipping, the operation of a wind farm).	Pressure description: Any loud noise made onshore or offshore by construction, vehicles, vessels, tourism, mining etc. that may disturb birds and reduce time spent in feeding or breeding area. Only relevant to birds and sea mammals that spend time on land for breeding purposes (haul-outs). It is unlikely to be relevant to habitat sensitivity assessments. N.B. NB: MSFD indicator (2010) states “the proportion of days within a calendar year, over areas of 15’N x 15’E/W in which anthropogenic sound sources exceed either of two levels, 183 dB re 1 µPa2.s (i.e. measured as Sound Exposure Level, SEL) or 224 dB re 1 µPa peak (i.e. measured as peak sound pressure level) when extrapolated to one metre, measured over the frequency band 10 Hz to 10 kHz”
Visual disturbance	Benthic species/Fish/Birds	Daily duration of transient visual cues exceeds 10% of the period of site occupancy by the feature	The disturbance of biota by anthropogenic activities, e.g. increased vessel movements, such as during construction phases for new infrastructure (bridges, cranes, port buildings etc.), increased personnel movements, increased tourism, increased vehicular movements on shore etc. disturbing bird roosting areas, seal haul out areas etc.	Visual disturbance is only relevant to species that respond to visual cues, for hunting, behavioural responses or predator avoidance, and that have the visual range to perceive cues at distance. It is particularly relevant to fish, birds, reptiles and mammals that depend on sight but less relevant to benthic invertebrates. The cephalopods are an exception but they are only likely to respond to a visual disturbance at close range (from e.g. divers). Sea horses are disturbed by photographic flash units but again at close range. It is unlikely to be relevant to habitat sensitivity assessments.
Water flow (tidal current) changes, including sediment transport considerations		A change in peak mean spring bed flow velocity of between 0.1 m/s to 0.2 m/s for more than 1 year	Changes in water movement associated with tidal streams (the rise and fall of the tide, riverine flows), prevailing winds and ocean currents. The pressure is therefore associated with activities that have the potential to modify hydrological energy flows, e.g. tidal energy generation devices remove (convert) energy and such pressures could be manifested leeward of the device, capital dredging may deepen and widen a channel and therefore decrease the water flow, canalisation and/or structures may alter flow speed and direction; managed realignment (e.g. Wallasea, England). The pressure will be spatially delineated.	None

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
			The pressure extremes are a shift from a high to a low energy environment (or *vice versa*).	
			The biota associated with these extremes will be markedly different as will the substratum, sediment supply/transport and associated seabed/ground elevation changes. The potential exists for profound changes (e.g. coastal erosion/deposition) to occur at long distances from the construction itself if an important sediment transport pathway was disrupted. As such these pressures could have multiple and complex impacts associated with them.	None
Wave exposure changes		A change in nearshore significant wave height >3% but <5% for one year	Local changes in wave length, height and frequency. Exposure on an open shore is dependent upon the distance of open sea water over which wind may blow to generate waves (the fetch) and the strength and incidence of winds. Anthropogenic sources of this pressure include artificial reefs, breakwaters, barrages, wrecks that can directly influence wave action or activities that may locally affect the incidence of winds, e.g. a dense network of wind turbines may have the potential to influence wave exposure, depending upon their location relative to the coastline.	Further research is required on the correlation between significant wave height and wave exposure scales. Subject to further revision.

Additional Pressures (from Natural England Commissioned Report NECR213) to Accommodate Marine Mammals and Birds

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
Vibration	Birds, Fish, mammals	Particle motion equivalent for MSFD indicator levels (SEL - Sound Exposure Level or peak SPL - Sound Pressure Level) exceeded in areas used by features	Aquatic animals are sensitive to particle motion therefore vibration alone will present a significant direct disturbance to some species. In addition to direct vibration sources (e.g. drilling, trawling, piling etc.) energy from substrate vibrations can enter the water column and sound waves which are likely to produce pressure components of sound and cause similar effects as those discussed in 'underwater noise'.	None
Above water noise	Birds, mammals	The introduction of airborne noise above background	This pressure relates to any loud noise made onshore or offshore by construction, vehicles (including aircraft), vessels,	None

ICG-C Pressure	Applies To	Benchmark	Pressure Description	Comment
		levels during periods of site occupancy by the feature	tourism, mining, blasting etc. that may disturb birds and reduce time spent in feeding or breeding area.	
Above water collision	Birds	The introduction of aerial structures or devices that introduce collision risk in areas used by features	This pressure related to the injury or mortality of biota from both static and / or moving structures	None

Appendix C: Benchmarks

Table C1. Benchmarks

ICG-C Pressure	Benchmark	Comment on Benchmark
Above water noise	The introduction of airborne noise above background levels during periods of site occupancy by the feature	If evidence of the airborne noise created exists or is measurable, it is easy to assess whether activity-pressure exceeds the benchmark. Expert judgement may be applied with relative confidence if evidence/quantitative measures are unavailable.
Abrasion/disturbance of the substrate on the surface of the seabed	Damage to surface features (e.g. species and physical structures within the habitat)	Benchmark as worded assumes any damage to surface features would be above the benchmark. Application of this benchmark in the present study results in many activity-pressures being assessed as having a medium to high likelihood of exceeding the benchmark because there is the possibility of damage to surface feature, regardless of the severity or area of damage.
Barrier to species movement	Permanent or temporary barrier to species movement over ≥50% of water body width or a 10% change in tidal excursion	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Changes in suspended solids (water clarity)	A change in one rank on the WFD (Water Framework Directive) scale e.g. from clear to intermediate for one year.	Difficult to relate evidence to WFD criteria as this is water body specific. Evidence presented is therefore not typically presented in the direct context of the benchmark.
Collision ABOVE water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures)	The introduction of aerial structures or devices that introduce collision risk in areas used by features	Benchmark as worded assumes any activity involving a non-natural object above water which has the potential to pose a collision risk would be above the benchmark
Collision BELOW water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures)	0.1% of tidal volume on an average tide, passing through artificial structure	Current benchmark is not relevant to assessment of this pressure for mobile objects not naturally found in the marine environment (e.g. boats) - should state in relation to static artificial structures.
Deoxygenation	Exposure to dissolved oxygen concentration of less than or equal to 2 mg/l for 1 week (a change from WFD poor status to bad status).	No comment on benchmark
Electromagnetic changes	Local electric field of 1 V/m. Local magnetic field of 10 µT	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Emergence regime changes, including tidal level change considerations	A change in the time covered or not covered by the sea for a period of ≥ 1 year Or An increase in relative sea level or decrease in high water level for ≥ 1 year.	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Genetic modification and translocation of indigenous species	Translocation of indigenous species and/or introduction of genetically modified or genetically different populations of indigenous species that may result in changes in genetic	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided

ICG-C Pressure	Benchmark	Comment on Benchmark
	structure of local populations, hybridization, or change in community structure.	
Habitat structure changes - removal of substratum (extraction)	Extraction of substratum to 30 cm (where substratum includes sediments and soft rocks but excludes hard bedrock)	Evidence likely to be limited in terms of units stated requiring expert judgement where evidence unavailable
Hydrocarbon and PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls	Evidence is typically available for individual contaminants. If a single substance has the potential to fail the respective standard as a result of the activity this has been assumed to have the potential to be above the benchmark. Benchmark does not account for existing background levels of contaminants (e.g. in absence of activity).
Introduction of light	Change in incident light via anthropogenic means.	Benchmark as worded assumes any change in incident light would be above the benchmark.
Introduction of microbial pathogens	The introduction of relevant microbial pathogens or metazoan disease vectors to an area where they are currently not present (e.g. *Martelia refringens* and *Bonamia*, Avian influenza virus, viral Haemorrhagic Septicaemia virus).	It is unclear how to apply benchmark if there is any uncertainty whether the activity has previously resulted in the introduction of relevant microbial pathogens/disease vectors.
Introduction of other substances (solid, liquid or gas)	Compliance with all AA EQS, conformance with PELs, EACs/ER-Ls	Evidence is typically available for individual contaminants. If a single substance has the potential to fail the respective standard as a result of the activity this has been assumed to have the potential to be above the benchmark. Benchmark does not account for existing background levels of contaminants (e.g. in absence of activity).
Introduction or spread of invasive non-indigenous species (INIS)	The introduction of one or more invasive non-indigenous species (INIS)	Assume the benchmark relates to the introduction of one or more INNS which is not currently present in a site/locality/region (although evidence relating to this may be limited). Providing infrastructure in the marine environment has the potential to assist the spread rather than introduction of NIS – this is not captured under the current definition of the benchmark, however, unclear how this would be incorporated.
Litter	Introduction of man-made objects able to cause physical harm (surface, water column, sea floor and/or strandline)	No comment on benchmark
Nutrient enrichment	Compliance with WFD criteria for good status	Difficult to relate evidence to WFD criteria as these are water body specific. Evidence presented is therefore not typically presented in the direct context of the benchmark
Organic enrichment	A deposit of 100 gC/m²/yr	Evidence likely to be limited in terms of units stated requiring expert judgement where evidence unavailable
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Damage to sub-surface features (e.g. species and physical structures within the habitat)	Benchmark as worded assumes any damage to sub-surface seabed would be above the benchmark.

ICG-C Pressure	Benchmark	Comment on Benchmark
Physical change (to another seabed type)	2) Change from sedimentary or soft rock substrata to hard rock or artificial substrata or vice-versa.	No comment on benchmark
Physical change (to another sediment type)	1) Change in sediment type by one Folk class (based on UK SeaMap simplified classification).	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Physical loss (to land or freshwater habitat)	Permanent loss of existing saline habitat within site	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Radionuclide contamination	An increase in 10 µGy/h above background levels	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Removal of non-target species	Removal of features or incidental non-targeted catch (by-catch) through targeted fishery, shellfishery or harvesting at a commercial or recreational scale.	Non-target species are always likely to be caught (although greatly minimised for some fishing methods) hence as worded the benchmark indicates that any incidental by-catch exceeds the benchmark
Removal of target species	Removal of species targeted by fishery, shellfishery or harvesting at a commercial or recreational scale.	Benchmark as worded assumes any commercial or recreational scale fishery would be above the benchmark
Salinity decrease	A decrease or an increase in one MNCR salinity category outside the usual range of the biotope/habitat for one year. http://www.marlin.ac.uk/glossary/salinity	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Salinity increase	A decrease or an increase in one MNCR salinity category outside the usual range of the biotope/habitat for one year. http://www.marlin.ac.uk/glossary/salinity	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Smothering and siltation rate changes (Heavy)	‘Heavy’ deposition of up to 30 cm of fine material added to the habitat in a single discrete event	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Smothering and siltation rate changes (Light)	‘Light’ deposition of up to 5 cm of fine material added to the habitat in a single, discrete event	Evidence likely to be limited in terms of units stated requiring expert judgement where evidence unavailable
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls	Evidence is typically available for individual contaminants. If a single substance has the potential to fail the respective standard as a result of the sub-activity this has been assumed to have the potential to be above the benchmark. Benchmark does not account for existing background levels of contaminants (e.g. in absence of activity).
Temperature decrease	A decrease or an increase in 5°C for one month, or 2°C for one year.	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Temperature increase	A decrease or an increase in 5°C for one month, or 2°C for one year.	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided

ICG-C Pressure	Benchmark	Comment on Benchmark
Transition elements and organo-metal (e.g. TBT) contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Compliance with all AA EQS, conformance with PELs, EACs, ER-Ls	Evidence is typically available for individual contaminants. If a single substance has the potential to fail the respective standard as a result of the sub-activity this has been assumed to have the potential to be above the benchmark. Benchmark does not account for existing background levels of contaminants (e.g. in absence of activity).
Underwater noise changes	MSFD indicator levels (SEL or peak SPL) exceeded for 20% of days in calendar year	MSFD indicator is phrased in terms of “damage to marine species” which becomes receptor specific which will require the hearing sensitivity of features to be considered. 20% days per calendar year within site is very specific for collection of evidence and application of benchmark, and expert judgment will likely be required where evidence is limited. Application of benchmark in this study very difficult due to the above limitations and all judgements in working document considered to be low confidence
Vibration	Particle motion equivalent for MSFD indicator levels (SEL - Sound Exposure Level or peak SPL - Sound Pressure Level) exceeded in areas used by features	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Visual disturbance	Daily duration of transient visual cues exceeds 10% of the period of site occupancy by the feature	10% of the period of site occupancy (assumed per day) by the feature may be too specific for collection of evidence and application of benchmark, and expert judgement (with respect to severity as well as duration of disturbance) may be required where evidence is limited. Application of benchmark in this study very difficult due to the above limitations and all judgements in working document considered to be low confidence
Water flow (tidal current) changes, including sediment transport considerations	A change in peak mean spring bed flow velocity of between 0.1 m/s to 0.2 m/s for more than 1 year	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided
Wave exposure changes	A change in nearshore significant wave height >3% but <5% for one year	Not a relevant pressure arising from any activities in this study, hence no comment on benchmark provided

Data Archive Appendix

Data outputs associated with this project are archived on the Document Management System (DMS) on server–based storage at Natural Resources Wales.

The data archive contains:

[A] The final report in Microsoft Word and Adobe PDF formats.

[B] A full set of data outputs in spreadsheet format (.xlsx format).

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue

https://libcat.naturalresources.wales (English Version) and https://catllyfr.cyfoethnaturiol.cymru (Welsh Version)

by searching 'Dataset Titles'.

The metadata is held as record no 121391.

The Activity / Pressure spreadsheet can be requested from NRW. Please contact datadistribution@naturalresourceswales.gov.uk.

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