

How much could marine protected areas contribute to Good Environmental Status?

Development of a practical assessment approach

March 2026

ENVIRONMENTAL
Standards Scotland
Ìrean Àrainneachdail na h-Alba

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Glossary

ESS – Environmental Standards Scotland

GES – Good Environmental Status

OSPAR – Oslo Paris Convention for the Protection of the Marine Environment of the North-East Atlantic

UKMS – United Kingdom Marine Strategy

EU MSFD – European Union Marine Strategy Framework Directive

MPAs – Marine Protected Areas

1. About this report

1.1 Environmental Standards Scotland's (ESS) strategic plan identified a number of analytical priorities. One of these is 'developing a better understanding of threats to the marine environment'. Following systematic scoping and evaluation, Seafloor Integrity was prioritised because of its importance for achieving Good Environmental Status (GES) under the UK Marine Strategy and its increasing exposure to human and climate-related pressures.

1.2 Section 20 of the UK Withdrawal from the European Union (Continuity) (Scotland) Act 2021 sets out the scope of ESS' functions. ESS' remit is to:

- ensure public authorities, including the Scottish Government, public bodies and local authorities, comply with environmental law
- monitor and take action to improve the effectiveness of environmental law and its implementation

1.3 ESS has prepared this technical paper as part of its remit to assess compliance with environmental law, and the effectiveness of environmental law or how it is implemented and applied. The relevant environmental law for this work is the Marine Strategy Regulations 2010. These regulations require the Scottish Government to set out how they will achieve GES through the UK Marine Strategy (UKMS).

1.4 The paper explores a method to quantify the potential contribution of marine protected areas in Scottish waters to targets for GES. We adapt the existing, internationally recognised framework (the BH3a indicator under the OSPAR Convention and UK Marine Strategy) to provide a practical method to estimate the contribution of spatial fisheries restrictions to achieving GES targets. Our assessment focuses on the potential impact of measures identified in the UK's 2015 Programme of Measures in Scottish waters.

1.5 Technical analysis papers are used by ESS to present detailed analytical evidence that underpin and inform our scrutiny work and decision-making processes. This technical report will be of interest to academics, public bodies and authorities responsible for setting and monitoring targets, and anyone interested in the scrutiny of these measures. Environmental Standards Scotland intends to use this work as part of its broader evidence base in examining how effectively Scottish public

authorities are fulfilling their duties under the UK Marine Strategy Regulations 2010. We expect to conclude this work later in 2026.

Suggested citation

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Sharing our code

The code we have used in this analysis will be available on GitHub: [Environmental Standards Scotland GitHub](#).

Data tables

All data tables in the report are reproduced in a supplementary .xlsx file here: [How much could marine protected areas contribute to Good Environmental Status? Development of a practical assessment approach - Environmental Standards Scotland](#)

2. Introduction

2.1 The EU Marine Strategy Framework Directive was transposed into UK legislation through the Marine Strategy Regulations 2010 (hereafter referred to as ‘The Regulations’). The Regulations placed an obligation on the Secretary of State and Devolved Administrations to take measures to achieve or maintain Good Environmental Status (GES) in the marine environment by 2020. To deliver GES, the Regulations required the UK to produce, and periodically update, a Marine Strategy, consisting of three parts [1]. **Part One** provides an assessment of marine waters, defines the UK’s interpretation of GES characteristics for eleven descriptors and sets associated targets and indicators. **Part Two** establishes a monitoring programme to track progress against those targets and indicators, while **Part Three** describes a ‘Programme of Measures’ to achieve or maintain GES.

2.2 Since The Regulations were introduced, the UK has published three ‘**Part One**’ assessments. The most recent assessment was published in 2025 and assessed status over the period 2016-2020. The preceding assessment was published in 2018, covering the period 2010-2015. There have been two publications under **Part Two** of the strategy, with an initial monitoring programme defined in 2014 and then updated in 2022. Similarly, there have been two **Part Three** Programmes of Measures published – one in 2015 and an update in 2025. The 2015 Programme of Measures (**Part Three**) concluded that, overall, the listed measures are sufficient for achieving or maintaining GES by 2020, while noting some exemptions relating to habitat recovery times [2]. The 2025 Programme of Measures **Part Three** makes no definitive statement on when the listed measures will deliver GES for those descriptors where it is yet to be met [3].

2.3 Within the two Part Three documents, a range of measures are set out for achieving GES for the Seafloor Integrity descriptor under the benthic habitats assessment, hereafter referred to as “benthic measures”. These measures include protected areas, which restrict or reduce the spatial extent of anthropogenic pressures on the benthic habitats, and fisheries legislation which also regulates the intensity and temporal distribution of fishing pressure on benthic habitats [2, 3]. Within the programmes of measures, a general description of each measure is provided, including a high-level statement on its contribution to achieving GES. For

example, the 2015 Programme of Measures states that “Marine Protected Areas [...] will make a significant contribution to achieving GES for benthic habitats.”

2.4 Both The Regulations and the EU MSFD require that information on how measures contribute to GES is included in the Programme of Measures. The European Commission guidance is generally non-specific in terms of how the contributions should be analysed, but it does make clear that the analysis should allow Member States to assure themselves that measures are sufficient to achieve targets and GES. More specifically, the guidance states that “it is important to assess how far the existing spatial protection measures solely or in combination with other non-spatial measures applicable inside and outside of MPAs and targeting, for example, certain pressures, are sufficient to meet the MSFD environmental targets” [4]. Beyond the high-level statements included in the Programmes of Measures, there is no publicly available assessment from the UK Government or Devolved Administrations on how benthic measures will contribute to GES. This lack of detailed assessment introduces challenges when seeking to scrutinise the relevant authority’s approach to developing measures and independently assess whether the listed measures can be considered effective and sufficient to achieve GES. These, and similar, issues were noted by the European Commission, which concluded that the UK does not always provide sufficient details about measures to understand how they will contribute to achieving GES in its assessment of Member States’ Programmes of Measures [5]. The Commission reached the same conclusion for seven other Member States in its assessment.

2.5 The challenge of assessing the contribution of measures is further exacerbated by the lack of quantitative thresholds for GES under the UK Marine Strategy. The benthic habitats assessment uses multiple targets and indicators for GES, covering aspects such as habitat extent and condition. Among these, the physical disturbance target is one of a few indicators with a clearly defined quantitative threshold. This target is assessed using the BH3a indicator, developed by the OSPAR Regional Seas Convention as part of its overarching assessment of the health of the North-East Atlantic. The BH3a indicator calculates the percentage of seabed area exposed to defined categories of disturbance from mobile bottom-contacting fishing gear, accounting for habitat distribution and sensitivity [6]. The UK Marine Strategy Part One benthic habitats assessment replicates this internationally recognised

framework, using the BH3a indicator to evaluate GES against thresholds for physical disturbance specified in Part One.

2.6 Both UK programmes of measures specify spatial protection measures for benthic habitats in sufficient detail to conceptually allow a quantitative estimate of their contribution to achieving GES for physical disturbance targets, given that precise thresholds for the BH3a indicator are provided. Because these measures directly influence the location, intensity, and timing of bottom-contacting fishing activity, it should be feasible to translate reductions in activity within protected areas into expected changes in BH3a disturbance categories. While such estimates would only capture one component of the overall suite of measures needed to achieve benthic GES, they provide valuable evidence to support scrutiny of other, less-specific measures and targets. This type of contribution assessment would align with European Commission guidance, which recommends assessing whether spatial protection measures, alone or in combination with other management actions, are sufficient to meet environmental targets.

2.7 This paper outlines a method for quantifying the *potential* contribution of spatial protection measures to limiting fishing-related physical disturbance in line with defined thresholds under the UK Marine Strategy. The method is applied to measures identified in the UK 2015 Programme of Measures to demonstrate its practical use and provide indicative results. Specifically, the analysis explores whether the level of physical disturbance in Scotland in 2020 (as defined in our methods) would have aligned with the threshold used to assess GES if the spatial measures in the UK 2015 Programme of Measures were fully implemented. The purpose of this work is to examine whether such quantification, through adapting the established assessment framework, is both feasible and reasonable as part of the development of a Programme of Measures. The analysis is illustrative rather than prescriptive; it does not seek to make definitive judgments on the overall effectiveness of spatial measures in achieving GES under The Regulations, nor does it seek to critique the BH3a methodology or its suitability as an indicator for physical disturbance targets.

2.8 This analysis forms part of broader scrutiny by Environmental Standards Scotland to examine how effectively Scottish Ministers and other public authorities are fulfilling their duties under The Regulations.

3. Methods

3.1 The latest BH3a indicator methodology for assessing physical disturbance to benthic habitats from bottom-contacting fishing gear is described in the OSPAR Quality Status Report 2023 [6]. To calculate physical disturbance scores up to a maximum of 9 (highest disturbance), three spatial data layers are combined (see Figure 1):

- i. **Composite habitat map.** This is based on EUNIS (European Nature Information System) habitat type.
- ii. **Sensitivity layer.** Derived using the Marine Evidence-based Sensitivity Assessment (MarESA) approach with the composite habitat map and species point data submitted to OSPAR. Resistance and resilience scores are combined to produce a sensitivity matrix with scores ranging from 1 to 5.
- iii. **Pressure layer.** Surface and subsurface swept area ratio (SAR) values are calculated per $0.05^\circ \times 0.05^\circ$ grid cells ('c-square') using vessel monitoring system (VMS) data from vessels > 12 m. The SAR values are assessed for variability over the assessment period, and an aggregated category assigned reflecting the relative intensity of pressure with scores ranging from 1 to 5.

3.2 The BH3a output is a multi-part spatial feature layer in which polygons representing distinct disturbance scores may be spatially disconnected but are stored within a single feature. Each polygon carries an attribute indicating its associated disturbance score (up to 9), which enables subsequent spatial clipping and area-based aggregation by disturbance category. Under the OSPAR BH3a method, areas subject to *any* fishing pressure (i.e. there is recorded VMS) but lacking habitat or sensitivity data are classified as "unassessed" disturbance. However, areas which lack habitat or sensitivity data, but have no fishing pressures (i.e. no reported VMS) are categorised as "Zero" disturbance rather than unassessed on the assumption that it is unlikely that fishing occurs within those areas [6].

3.3 To estimate the contribution of spatial protection measures to physical disturbance targets, we modify the pressure layer within the BH3a calculation to simulate the exclusion of bottom-contacting fishing gear. The updated pressure layer is then recombined with the habitat and sensitivity layers to calculate hypothetical physical disturbance scores across the region (Figure 1.)

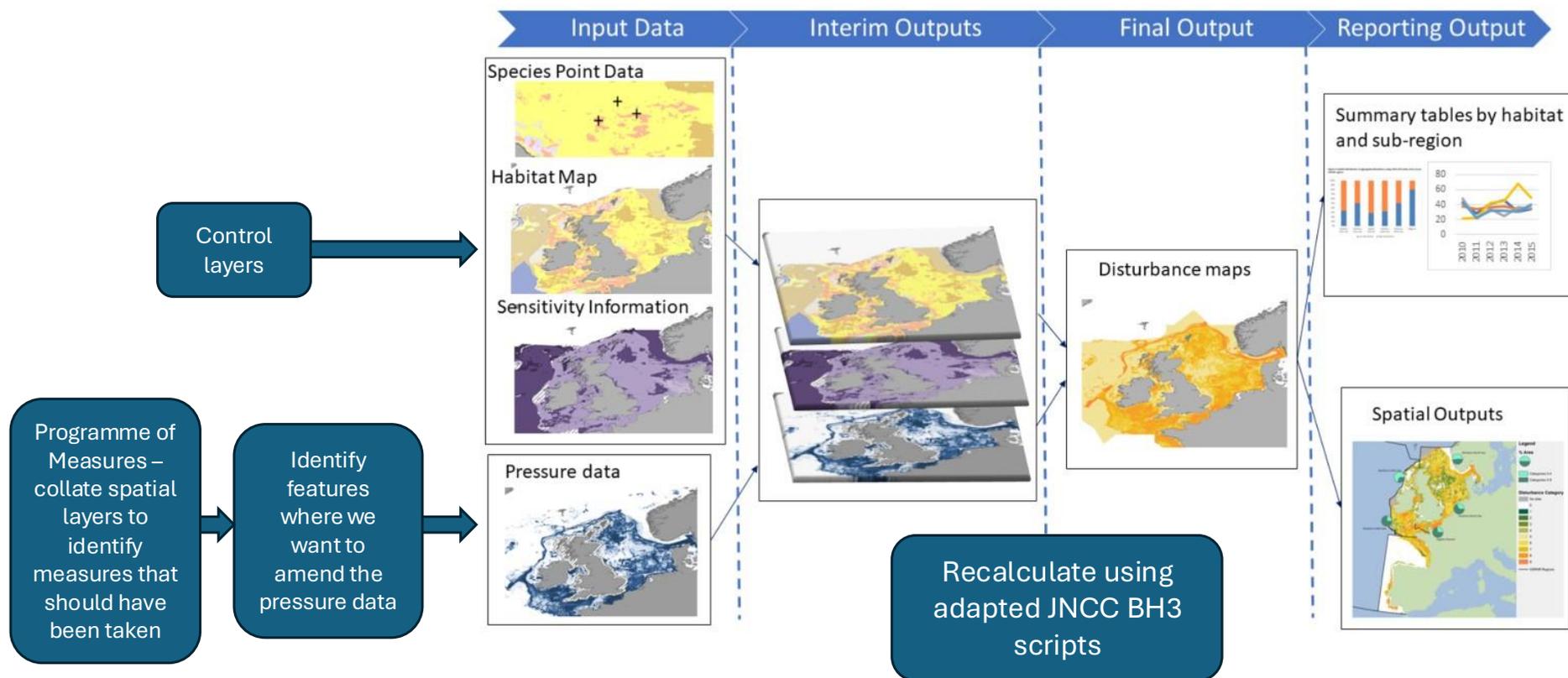


Figure 1 Overview of methodology to estimate the contribution of spatial protection measures to physical disturbance targets by modifying the pressure layer within the BH3a calculation to simulate the exclusion of bottom-contacting fishing gear. Modified visual from figure 1, OSPAR 2023

3.4 It is important to note that any application of this method during the development of a Programme of Measures would rely on historic fishing data. Therefore, it does not represent a forecast of post-implementation conditions. Changes in fishing effort following the introduction of spatial measures, including displacement, changes in fleet composition, or technological developments, are not captured. Results should therefore be interpreted as indicative of potential effects rather than as predictions of realised outcomes.

3.5 Sections 3.13-3.20 describe our application of this method, assessing disturbance levels against two GES threshold criteria.

- i) Threshold criteria 1: GES is achieved when <15% of the seafloor is exposed to disturbance scores 5-9. This criteria was used to evaluate GES status with the BH3a indicator in the 2018 Part One assessment [7].
- ii) Threshold criteria 2: GES is achieved when <15% of the seafloor is exposed to disturbance scores 8-9 **and** <25% of seafloor is exposed to disturbance scores 5-9. This criteria was used to evaluate GES status with the BH3a indicator in the 2025 Part One assessment [8].

3.6 All analysis was carried out in R 4.4.2 and QGIS 3.28.15 – Firenze, using modified R scripts available from OSPAR QSR 2023 (ODIMS - Submission: OSPAR Extent of Physical Disturbance to Benthic Habitats - Data Snapshot). No open-source code was available for UK Part One Assessments.

Study region

Disturbance calculations using each GES threshold criteria were applied in two geographies:

1. The Scottish portion of the regions used in the 2018 UK Marine Strategy Part One assessment, relating to the Northern North Sea and Northern Celtic Seas sub-regions only. Referred to as “the 2018 boundaries”
2. The Scottish portion of the regions used in the 2025 UK Marine Strategy Part One assessment, relating to the Central North Sea and Northern Celtic Seas sub-regions only. Referred to as the “the 2025 boundaries”

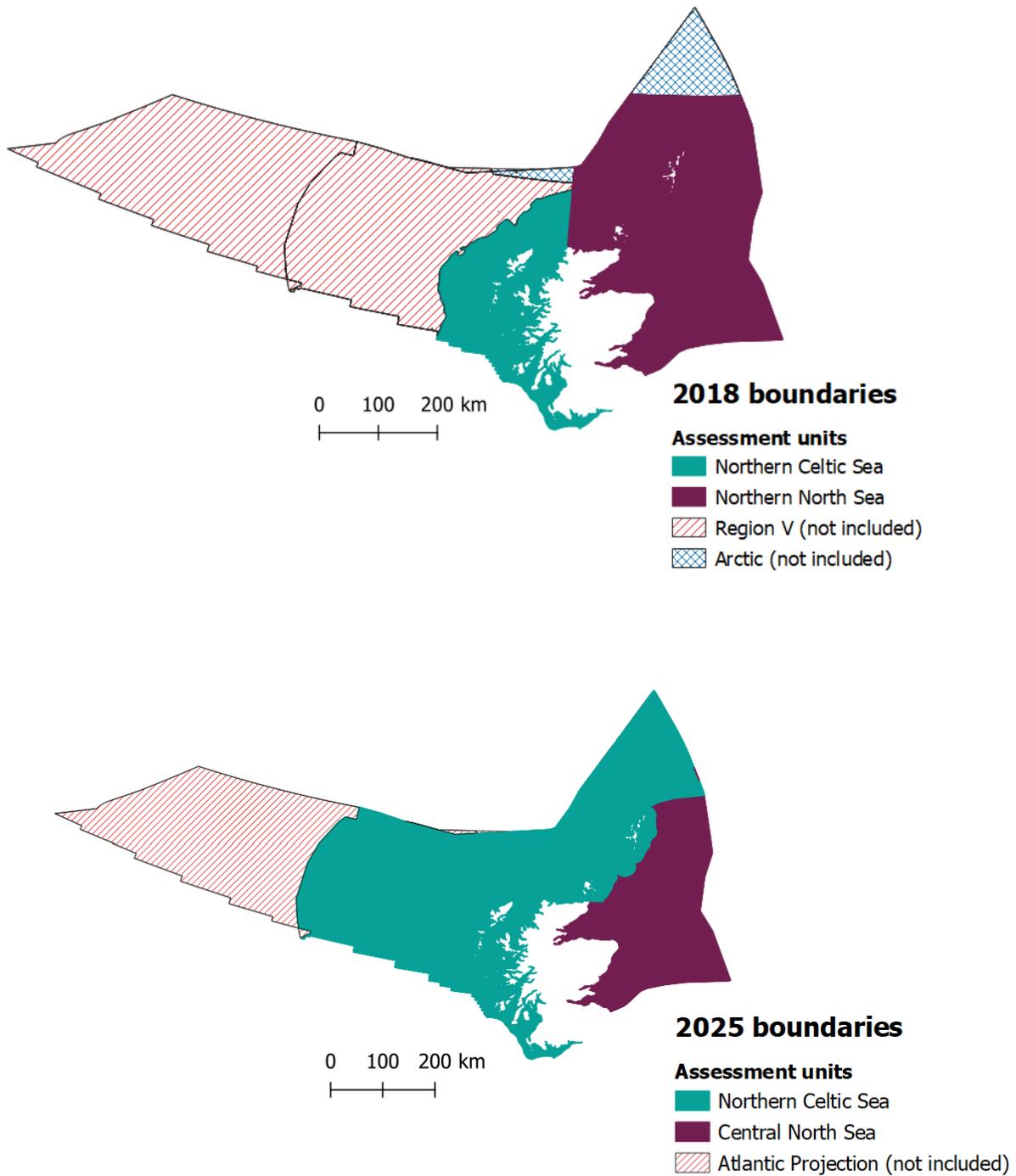


Figure 2 Boundaries definitions and sub-regions used in analysis to calculate disturbance levels before and after spatial protection measures. (A) 2018 boundaries as used in the 2018 UK Part One Assessment (B) 2025 boundaries as used in the 2025 Part One Assessment.

3.7 Figure 2 shows how these regions are defined and demonstrates the change to the boundaries and sub-region terminology between the 2018 and 2025 Part One assessments. To generate the regions, the 2023 OSPAR Quality Status Report BH3a assessment data and spatial layers (available here [9]) were spatially clipped to the relevant boundaries (as above). This approach mirrors the method used in the UK Marine Strategy Part One reports (2018 and 2025), in which the OSPAR BH3a analysis 2017 and 2023, respectively, were clipped to the area of seafloor within the UK Marine Strategy area [7, 8].

3.8 The regions were selected to align with the UK Marine Strategy assessments and to allow a focus on spatial protection measures under the jurisdiction of the Scottish Government. The Scottish portions were defined by intersecting Scottish marine regions (inshore and offshore) with the OSPAR or MSFD sub-regions relevant to the 2018 and 2025 assessments of the Celtic Seas and North Sea respectively.

Spatial measures

3.9 The spatial measures included in the analysis were protected areas designated under the Marine Scotland Act 2010 and the Habitats Directive (92/43/EEC). These are listed as key measures in the 2015 UK Programme of Measures and include Marine Protected Areas (MPAs) and Special Areas of Conservation (SACs). We included MPAs or SACs designated for any feature (including non-benthic features) before the 31 December 2020, given the date of 2020 for achieving GES set out in The Regulations. A list of the sites included in the analysis is provided in the supplementary material 5.1.

3.10 For the purposes of this illustrative analysis, and to demonstrate our method, we have assumed full site closures to bottom-contacting fishing gear, implemented at the time of site designation. This assumption does not reflect current arrangements for Scottish MPAs and SACs, which can have partial or no exclusion of bottom-contacting fishing gear, and often measures to manage fishing activity are introduced several years after designation of the site.

Fishing data

3.11 The pressure layer for our analysis used fishing data published alongside the 2023 OSPAR Quality Status report. This data represents fishing activity from the majority of OSPAR countries between 2016-2020 for vessels transmitting VMS. The time-period reflects the implementation period between the UK 2015 Programme of Measures and the target date to achieve or maintain GES under The Regulations. A detailed description of which vessels are included is provided by OSPAR [10]. Specifically, the dataset only includes vessels longer than 12 metres, which are required to carry VMS. As a result, smaller inshore vessels, which do not transmit VMS, are not captured in this dataset and their fishing activity is therefore excluded from the analysis. The exclusion of inshore vessels is consistent with the UK's assessment approach and targets for physical disturbance under the UK Marine Strategy.

3.12 Data from the OSPAR data snapshot [9] was clipped to the 2018 and 2025 boundaries (Section 2.2) and used to generate modified pressure layers simulating the disturbance scores with and without spatial protection measures. Given that the baseline pressure layer (i.e. without spatial protection measures) reflects fishing activity during 2016–2020, it will incorporate effects of any fisheries management measures that were already in place during this period. As a result, comparisons between the baseline and counterfactual closure scenarios represent additional effects of assumed full closures beyond those measures already implemented, rather than the total effect relative to an entirely unmanaged baseline [11].

Calculating disturbance scores and effect of measures

3.13 To quantify the contribution of spatial protection measures, pressure scores were modified to zero for grid cells where any portion of the cell occurred within the MPAs and SACs in the pressure layer. The modified pressure layer was then recombined with the unmodified (other than the boundary clips) composite habitat map and sensitivity layer to calculate new disturbance scores (up to 9).

3.14 Setting pressure scores to zero simulates a full closure to bottom-contacting fishing gear, reflecting the maximum potential effect of spatial protection measures on physical disturbance levels. Although the baseline VMS dataset used for the pressure layer does not capture smaller inshore vessels (<12 m), this does not

undermine the zero-score assumption, because (assuming full compliance with a closure) following spatial protection measures, all vessels, regardless of size or VMS reporting, would cease fishing within the protected area.

3.15 To estimate the percentage of seabed area according to the two GES threshold criteria, disturbance scores were aggregated by:

1. Region. For each sub-region, the area of seabed falling into each disturbance category was calculated and expressed as a percentage of the total seabed area of that sub-region under the respective 2018 and 2025 boundaries.
Percentage = (area of seabed in disturbance category X within sub-region) / (total seabed area of sub-region) × 100.
2. Broad-scale habitat. For each broad-scale habitat type within each sub-region, the area of seabed in each disturbance category was calculated and expressed as a percentage of the total area of that broad-scale habitat within the sub-region. Percentage = (area of habitat H in disturbance category X within sub-region) / (total area of habitat H within sub-region) × 100.

3.16 These two aggregations represent the methods used in the UK to evaluate GES status with the BH3a indicator in the 2018 and 2025 Part One assessments, respectively.

3.17 The broad-scale habitat data used in the UK 2025 Part One assessment were not available for this analysis. Instead, data from the OSPAR QSR 2023 were used. The OSPAR broad-scale habitat categories do not correspond exactly to those in the UK 2025 Part One, meaning that our results are not directly comparable (see supplementary material 5.2 for details). This difference may result from certain OSPAR habitats being aggregated under a single category in the UK assessment, although no methodological details are provided for the UK assessment. To make the closest possible comparison, OSPAR habitats containing the word “Abyssal” were combined into a single Abyssal category, while all other categories were left unchanged. This resulted in a total of 18 broad-scale habitats for our analysis.

3.18 The broad-scale habitat methodology used in the UK 2025 Part One assessment, calculates the percentage of seabed in each disturbance category for 20 broad-scale habitat types. The number of habitats achieving the GES threshold is

then expressed for each sub-region as a percentage of the habitats present, to determine whether a majority of habitats (by count of habitat types) meet GES.

3.19 All area calculations used the EPSG4326: WGS84 projection.

3.20 Overall, the threshold criteria, boundaries and aggregations provided eight spatial protection measure combinations of disturbance exposures, summarised in Table 1.

Table 1 Summary of the eight disturbance calculations according to different threshold, boundaries and aggregation methods

GES Threshold	Boundaries	Aggregation
<15% of the seafloor exposed to disturbance categories 5-9	2018	Regional
		Broad-scale habitat
	2025	Regional
		Broad-scale habitat
<15% of the seafloor exposed to disturbance categories 8-9 and <25% of seafloor is exposed to disturbance categories 5-9	2018	Regional
		Broad-scale habitat
	2025	Regional
		Broad-scale habitat

Validation and quality assurance

3.21 To validate our analysis code and ensure that our modification of OSPAR code did not introduce errors, 2023 OSPAR source data were re-run through our modified code to calculate disturbance scores and reproduce summaries for OSPAR 2023 QSR regions. These were compared to OSPAR QSR results. These returned the same results as the OSPAR 2023 assessment (see supplementary material 4.3).

4. Results

Baseline fishing pressure without additional spatial protection

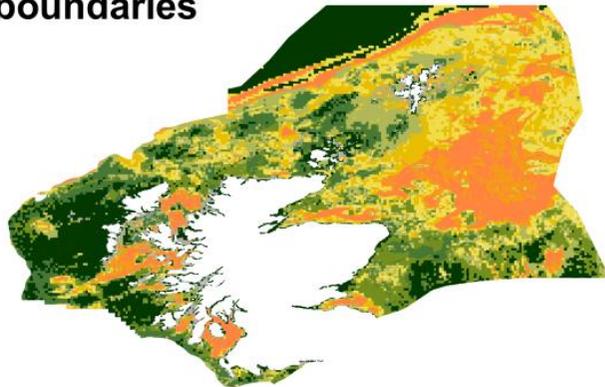
4.1 Disturbance scores within Scottish waters prior to additional spatial protection measures are shown in Figure 3. A substantial proportion of the seabed is classified as zero disturbance, reflecting the absence of recorded bottom-contacting fishing activity in the underlying VMS dataset. Under the 2018 boundaries, 32% of the Northern Celtic Seas sub-region is classified as zero disturbance prior to the application of spatial protection measures. Under the 2025 boundaries, this increases to 55% for the Northern Celtic Seas sub-region, reflecting the inclusion of additional offshore areas with limited recorded fishing activity.

4.2 Table 2 presents the baseline percentages of seafloor exposed to disturbance categories under GES threshold criteria 1 for the 2018 and 2025 boundaries. Under baseline conditions, neither sub-region meets the GES threshold under either the 2018 or 2025 boundaries. In all cases, the proportion of seafloor exposed to disturbance categories 5–9 exceeds the threshold.

Table 2 Baseline seafloor exposure to disturbance categories for GES threshold criteria 1 (< 15% in categories 5-9), according to regions under the 2018 and 2025 boundaries. Shaded rows represent the disturbance categories used to evaluate GES threshold 1 criteria

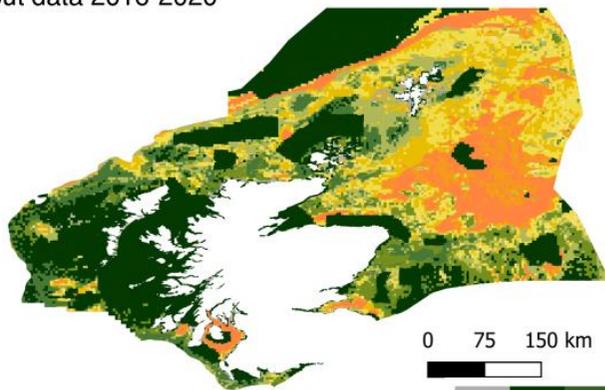
Disturbance category	2018 boundaries		2025 boundaries	
	Northern Celtic Seas	Northern North Sea	Northern Celtic Seas	Central North Sea
5-9	22%	53%	25%	62%
1-4	42%	33%	19%	31%
Zero	32%	14%	55%	7%
Unassessed	3%	-	1%	0%
Total area km ²	79,411	202,613	337,138	120,852

2018 boundaries



baseline fishing data 2016-2020

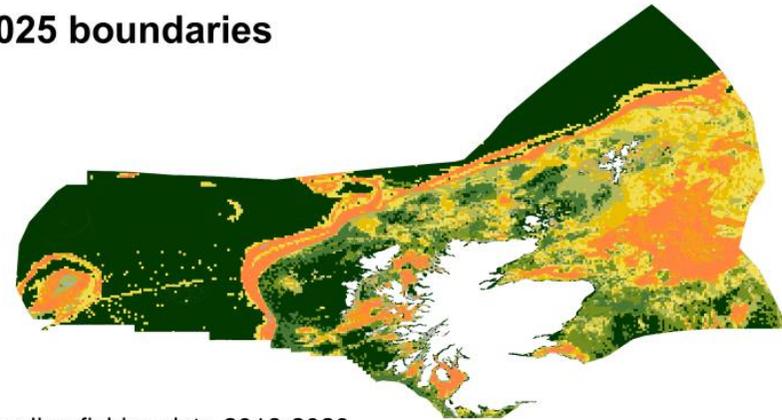
ESS input data 2016-2020



0 75 150 km

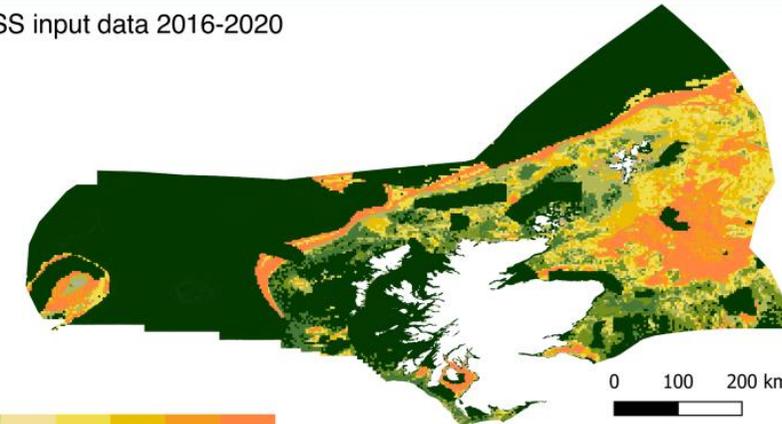


2025 boundaries



baseline fishing data 2016-2020

ESS input data 2016-2020



0 100 200 km

Figure 3 Illustrative examples of sea floor disturbance scores using baseline fishing data compared to ESS input data. The left hand side of the figure shows the spatial extent covered by the Scottish portions of 2018 boundaries for Northern Celtic Seas and Northern North Sea, and the right hand side of the figure shows the Scottish portions of 2025 boundaries for Northern Celtic Seas and Central North Sea

4.3 Baseline disturbance results under GES threshold criteria 2 are shown in Table 3. Using this threshold (<15% of the seafloor within categories 8-9 and <25% of seafloor within categories 5-9), the proportion of disturbance in the Northern Celtic Seas sub-region would be consistent with achieving GES under the 2018 boundaries prior to spatial protection measures. Under the 2025 boundaries, the Northern Celtic Seas sub-region would marginally exceed the combined 5-9 threshold criteria. In both North Sea sub-regions, baseline disturbance would exceed the GES threshold criteria 2 under the 2018 and 2025 boundaries.

Table 3 Baseline seafloor exposure to disturbance categories for GES threshold criteria 2 (<15% of the seafloor within categories 8-9 and <25% of seafloor within categories 5-9), according to regions under the 2018 and 2025 boundaries. Shaded rows represent the disturbance categories used to evaluate GES, with bold text indicating the threshold criterion is met.

Disturbance category	2018 boundaries		2025 boundaries	
	Northern Celtic Seas	Northern North Sea	Northern Celtic Seas	Central North Sea
8-9	11%	22%	11%	30%
5-7	11%	31%	15%	32%
1-4	42%	33%	20%	31%
Zero	32%	14%	55%	7%
Unassessed	3%	-	1%	0%
Combined 5-9	22%	53%	25%	62%
Total area km ²	79,411	202,613	337,138	120,852
	Combined 5-9 is the sum of 8-9 and 5-7. Individual percentages may not sum to totals due to rounding.			

Effect of spatial protection measures – regional aggregation

4.4 Reducing pressure scores to zero for grid cells within MPAs and SACs in the pressure layer results in a reduction in the proportion of seafloor exposed to

disturbance categories greater than zero across all sub-regions and boundaries. Figure 3 shows the change in disturbance scores when applying this methodology.

4.5 Results for GES threshold criteria 1, following the application of spatial protection measures, are presented in Table 4. The largest reduction in disturbance between the baseline and measures (-13% for disturbance categories 5-9 and 1-4) is observed for the Northern Celtic Seas using the 2018 boundaries.

Table 4 Seafloor exposure to disturbance categories after implementation of spatial protection measures against GES threshold criteria 1. Figures in brackets show the change relative to baseline figures in Table 2. Shaded rows represent the disturbance categories used to evaluate GES, with bold text indicating the threshold criterion is met.

Disturbance category	2018 boundaries		2025 boundaries	
	Northern Celtic Seas	Northern North Sea	Northern Celtic Seas	Central North Sea
5-9	9% (-13%)	48% (-5%)	16% (-9%)	58% (-4%)
1-4	29% (-13%)	27% (-6%)	14% (-5%)	27% (-5%)
Zero	61% (+28%)	25% (+11%)	70% (+15%)	16% (+9%)
Unassessed	1% (-2%)	0%	0% (-1%)	0%
Total area km ²	79,411	202,613	337,138	120,852

4.6 Following the application of spatial protection measures, within the parameters of this model, the Northern Celtic Seas sub-region would meet or would be very close to meeting the GES threshold criteria 1 under the 2018 and 2025 boundaries. Under the 2025 boundary definition, the threshold for achieving GES is not met by a single percentage point. In contrast, disturbance levels in the North Sea sub-regions remain well above the GES threshold criteria 1 under both boundary definitions. Taken solely on these results, GES would not be achieved (with the caveat that the spatial measures are only one element of the overall suite of measures set out in the Programme of Measures).

4.7 Results for GES threshold criteria 2, following spatial protection measures, are shown in Table 5. As with GES threshold criteria 1, the greatest reductions in disturbance categories occur in the Northern Celtic Seas sub-region. Disturbance levels in the Northern Celtic Seas sub-region are below the GES thresholds under both boundaries following spatial protection measures under threshold criteria 2. In the North Sea sub-regions, disturbance levels remain above GES threshold criteria 2, and GES would not be achieved under either boundary definition.

Table 5 Seafloor exposure to disturbance categories after implementation of spatial protection measures against GES threshold criteria 2. Figures in brackets show the change relative to baseline figures shown in Table 3. Shaded rows represent the disturbance categories used to evaluate GES, with bold text indicating the threshold criterion is met

Disturbance category	2018 boundaries		2025 boundaries	
	Northern Celtic Seas	Northern North Sea	Northern Celtic Seas	Central North Sea
8-9	3% (-8%)	20% (-2%)	6% (-4%)	27% (-3%)
5-7	6% (-5%)	28% (-3%)	9% (-5%)	30% (-2%)
1-4	29% (-13%)	27% (-6%)	14% (-5%)	26% (-5%)
Zero	60% (+28%)	25% (+11%)	70% (+15%)	16% (+9%)
Unassessed	1% (-2%)	0	0% (-1%)	0%
Combined 5-9	9% (-13%)	48% (-5%)	16% (-9%)	57% (-4%)
Total area km ²	79,411	202,613	337,138	120,852

4.8 Across both threshold criteria and boundaries, the contribution of spatial protection measures to reducing disturbance is consistently greater in the Northern Celtic Seas sub-region than in the North Sea sub-regions. Disturbance levels in the North Sea sub-regions remain above GES thresholds criteria, indicating a smaller contribution of spatial protection measures alone to achieving GES in this region.

4.9 Changes in the proportion of seafloor classified as unassessed are evident following application of spatial protection measures (Tables 4 and 5). These changes

arise from the interaction between fishing pressure and the BH3a disturbance calculation method and should be interpreted as a consequence of pressure removal rather than improved data coverage. As described in paragraph 4.2, under the OSPAR BH3a method, areas with recorded fishing pressure but lacking habitat or sensitivity data are classified as “unassessed,” whereas areas without any recorded fishing pressure and lacking habitat or sensitivity data are classified as zero disturbance, based on the assumption that it is unlikely that fishing has occurred in these areas [6]. In our analysis, reducing fishing pressure to zero within protected areas causes some grid cells that were previously unassessed (because of missing habitat or sensitivity data) to be reclassified as zero disturbance. This modification is reasonable because the analysis simulates full closure of protected sites to bottom-contacting fishing gear. Under these conditions, the absence of fishing means that the addition of habitat or sensitivity data would not change the disturbance classification. Even if the OSPAR assumption that fishing is unlikely to have occurred in areas with no VMS is less accurate for the baseline (due to exclusion of <12 m vessels from the VMS dataset), a zero disturbance score in protected area becomes valid after the implementation of spatial protection measures, assuming full compliance.

Effect of spatial protection measures – broad-scale habitat aggregation

4.10 Broad-scale habitat results are summarised using the same majority-based approach applied in the UK 2025 Part One assessment in Table 6 and Table 7, whereby the number of habitat types meeting GES thresholds is expressed as a proportion of the total number of habitats present.

4.11 Under GES threshold criteria 1 and the 2018 boundary, application of spatial protection measures results in one additional broad-scale habitat achieving GES in the Northern North Seas sub-region relative to the baseline, compared to three in the Northern Celtic Seas (Table 6). Under the 2025 boundary, four broad-scale habitats achieve GES in both the Northern Celtic Seas and Central North Sea sub-regions following spatial protection measures. Under this boundary, a majority of habitats (by count) achieve GES in both sub-regions following spatial protection measures.

Table 6 Broad-scale habitat status after spatial protection measures under GES threshold criteria 1 for the Northern Celtic Sea (NCS), Northern North Sea (NNS) and Central North Sea (CNS). A = GES achieved, UA = GES unachieved, NP = habitat not present. Percentages of habitats meeting GES are calculated using only habitats present within each sub-region. Shaded cells represent habitats which changed from unachieved in the baseline to achieved after spatial protection measures

Broadscale habitats	2018 boundaries		2025 boundaries	
	NCS	NNS	NCS	CNS
Infralittoral rock and biogenic reef	A	UA	A	A
Infralittoral coarse sediment	A	A	A	A
Infralittoral mixed sediment	UA	UA	UA	UA
Infralittoral sand	A	A	A	A
Infralittoral mud	A	A	A	A
Circalittoral rock and biogenic reef	A	UA	A	UA
Circalittoral coarse sediment	A	UA	A	A
Circalittoral mixed sediment	UA	UA	UA	UA
Circalittoral sand	A	UA	A	A
Circalittoral mud	UA	UA	UA	UA
Offshore circalittoral rock and biogenic reef	A	A	A	A
Offshore circalittoral coarse sediment	A	A	A	A
Offshore circalittoral mixed sediment	A	A	A	A
Offshore circalittoral sand	UA	UA	UA	UA
Offshore circalittoral mud	UA	UA	UA	UA
Upper bathyal rock and biogenic reef	NP	NP	A	NP
Lower bathyal rock and biogenic reef	NP	NP	A	NP
Abyssal	NP	NP	A	NP
Assessment % achieved - (baseline figures in brackets)	67% (47%)	40% (33%)	72% (50%)	60% (33%)

4.12 Under the GES threshold criteria 2 and prior to spatial protection measures, a majority (67%) of broadscale habitats in the Northern Celtic Seas and nearly half (47%) of North Sea regions achieve GES under both boundary definitions. Following application of spatial protection measures, four broad scale habitats move from unachieved to achieved in the Northern Celtic Seas and two habitats move from unachieved to achieved in the Northern North Sea under the 2018 boundary definition (Table 7). Under the 2025 boundary definition, three broad scale habitats move from unachieved to achieved in the Northern Celtic Seas and two habitats move from unachieved to achieved in the Northern North Sea under the 2025 boundary definition. Under criteria 2, a majority of habitats achieve GES in both sub-regions following spatial protection measures regardless of boundary definition.

4.13 The highest proportion of habitats achieving GES is observed in the Northern Celtic Seas sub-region under the 2025 boundary definition following spatial protection measures, where only 1 out of the 15 broad scale habitats present did not achieve GES (Offshore Circalittoral mud).

4.14 It is important to note that the calculation of whether a majority of habitats achieve GES represents a simple count of habitats that have achieved or not achieved GES, in line with the UK 2025 Part One assessment methodology. This method does not account for the area of each broadscale habitat type within a sub-region. The area of each habitat type is highly variable within the sub-regions. For example, in the Northern Celtic Seas (2025 boundaries) circalittoral mixed sediment represents 355 km², whereas circalittoral coarse sediment represents 5553 km². The calculations therefore should not be considered to represent whether a majority of total habitat area within each sub-region achieves GES.

Table 7 Broad-scale habitat status after spatial protection measures under GES threshold criteria 2 for the Northern Celtic Sea (NCS), Northern North Sea (NNS) and Central North Sea (CNS). A = GES achieved, UA = GES unachieved, NP = habitat not present. Percentages of habitats meeting GES are calculated using only habitats present within each sub-region. Shaded cells represent habitats which changed from unachieved in the baseline to achieved after spatial protection measures

Broad-scale habitats	2018 boundaries		2025 boundaries	
	NCS	NNS	NCS	CNS
Infralittoral rock and biogenic reef	A	A	A	A
Infralittoral coarse sediment	A	A	A	A
Infralittoral mixed sediment	A	UA	UA	UA
Infralittoral sand	A	A	A	A
Infralittoral mud	A	A	A	A
Circalittoral rock and biogenic reef	A	UA	A	UA
Circalittoral coarse sediment	A	A	A	A
Circalittoral mixed sediment	A	UA	A	UA
Circalittoral sand	A	A	A	A
Circalittoral mud	A	UA	A	UA
Offshore circalittoral rock and biogenic reef	A	A	A	A
Offshore circalittoral coarse sediment	A	A	A	A
Offshore circalittoral mixed sediment	A	A	A	A
Offshore circalittoral sand	A	UA	UA	UA
Offshore circalittoral mud	UA	UA	UA	UA
Upper bathyal rock and biogenic reef	NP	NP	A	NP
Lower bathyal rock and biogenic reef	NP	NP	A	NP
Abyssal	NP	NP	A	NP
Assessment % achieved - (baseline figures in brackets)	93% (67%)	60% (47%)	83% (67%)	60% (47%)

5. Discussion

5.1 Understanding the extent to which proposed measures contribute to the achievement and maintenance of Good Environmental Status (GES) is a statutory requirement under The Regulations. To date, details on how benthic measures contribute to GES targets has been largely limited to high-level statements, with little quantitative underpinning of the magnitude of expected contributions. This lack of quantitative contribution estimates can constrain independent scrutiny of the processes by which Governments develop Programmes of Measures under The Regulations and limits the ability to assess whether proposed measures can reasonably be considered sufficient to deliver stated targets.

5.2 By modifying the pressure component of the OSPAR 2023 BH3a assessment, we have demonstrated that it is possible to quantify the potential impact of implementing the spatial protection measures. We have generated indicative results on the contribution of spatial protection measures in Scotland to physical disturbance targets. While the analysis does not quantify the contribution of all benthic measures identified within the UK Programme of Measures, it indicates that, within the specific confines of our methodology, disturbance levels in the Scottish portion of the Celtic Seas could be reduced near to, or below the thresholds for GES following implementation of identified spatial measures alone. However, disturbance levels in the North Sea sub-regions would remain appreciably above GES thresholds. This indicates that the efficacy of the spatial measures alone in the 2015 Programme of Measures is not uniform across the regions.

5.3 The analysis has highlighted a number of methodological features which were amended between the two UK Part One assessments, and which materially affect whether disturbance levels are considered consistent with GES. Firstly, the choice of boundary definitions, aggregation method (regional area-based versus habitat-by-habitat majority), and threshold definitions meaningfully alter conclusions on whether GES is achieved or not. Percentage-based thresholds using different total areas (for example a change to the Northern Celtic Seas boundaries) changes the denominator against which contributions are judged. Such changes can produce large differences in the apparent contribution of spatial protection measures even when the spatial distribution of pressure is unchanged. Secondly, indicator aggregation rules that count habitats equally (counting habitat types meeting a threshold) do not reflect

habitat extent and can obscure whether most seafloor area meets GES. Both issues reduce the clarity of what a “contribution” means in practice.

5.4 Estimating the contribution of proposed measures and assessing whether they are plausibly sufficient to meet targets using this, or any method, will be inherently difficult for Governments if the assessment approach for GES is not clearly specified at the point when measures are designed, or assessment rules are revised in subsequent reporting cycles. This challenge is particularly acute given the six-year reporting cycle of the Marine Strategy, under which assessment methods may change between the design of measures and their formal evaluation.

5.5 Data limitations constrain interpretation and should always be acknowledged when estimating the contribution of measures. Many of the limitations in this analysis are inherent to the OSPAR BH3a indicator as a metric for assessing physical disturbance to benthic habitats. These include assumptions regarding habitat sensitivity, pressure–impact relationships and incomplete data coverage. However, when assessing the contribution of proposed measures to statutory targets, it is both necessary and appropriate to apply the same indicator and assessment framework that underpins the formal determination of whether Good Environmental Status (GES) has been achieved. Using alternative metrics would reduce policy relevance and limit comparability with official assessments. Therefore, despite its known limitations, the BH3a indicator provides the most meaningful basis for evaluating the contribution of spatial protection measures to physical disturbance targets under the UK Marine Strategy, while it remains the official indicator. The limitations of the BH3a indicator and our analysis are discussed below to contextualise the results of this analysis rather than to critique the BH3a methodology itself.

5.6 A fundamental limitation of the BH3a-based analysis is the omission of fishing activity that contributes to physical disturbance but is not captured in VMS data or the OSPAR 2023 QSR. For example, activity from some States, including Portugal, Norway, and Iceland, which may operate in Scottish waters, is not included in the dataset. In addition, vessels <12 m are not required to carry VMS and are therefore excluded. These gaps generally bias overall disturbance estimates downwards. In the Scottish context, the exclusion of smaller inshore vessels from the analysis may be amplified in both our analysis and the UK Part One assessment because a substantial proportion of waters are coastal and therefore more likely to be impacted

by smaller inshore vessels. Supplementary fisheries information such as logbooks, observer data or forthcoming remote electronic monitoring data could mitigate these limitations. Should such data be incorporated into future UK Part One assessment of physical disturbance targets, any analysis of the contribution of spatial protection measures should also integrate this information.

5.7 A further important consideration for this analysis is that the available pressure layer is derived from 2016–2020 VMS records. As a result, the analysis compares a hypothetical full-closure scenario with a baseline that already incorporates some existing spatial protection measures during that period. However, the most recent report on Scottish MPAs confirms that, as of 2024, fisheries management measures had not yet been implemented for the majority of protected sites in Scottish waters. Consequently, the baseline used in this analysis likely represents limited pre-existing protection.[11].

5.8 The method used in our analysis should be considered as producing an upper-bound of the potential contribution of spatial protection measures. This is because the method assumes full exclusion of bottom-contacting gear from all designated sites (regardless of feature or actual site management) and applies closure from the date of designation. It also treats pressure as uniformly distributed within grid cells and, given it is based on historic VMS data rather than forecasting, cannot account for potential displacement effects that could lead to increased disturbance outside of protected areas. Displacement of fishing effort following the implementation of protected areas has the potential to materially affect the achievement of physical disturbance targets for GES and would be critical to consider in a comprehensive assessment of measure contributions. Empirical and modelling studies from the Northeast Atlantic context demonstrate that closure of fishing grounds can lead to effort redistribution into remaining open areas, with implications for benthic pressure and ecological outcomes [12]. However, reliable modelling of displacement responses requires detailed data on fisher behaviour, economics, gear selectivity, and spatial dynamics, which remain challenging to parameterise comprehensively at the spatial and temporal scales relevant to UK waters [13].

5.9 Notwithstanding the limitations, our analysis has demonstrated that the BH3a methodology can practically and feasibly be used to provide quantitative estimates on the potential contribution of spatial protection measures to physical disturbance

targets for benthic habitats. While the results should be treated as indicative rather than definitive statements on the sufficiency of measures or a predictive forecast of realised outcomes, they provide valuable evidence to support the development and assurance of measures under the UK Marine Strategy, and for fulfilling statutory duties in relation to assessing the contribution and technical feasibility of measures. In particular, the results highlight where spatial measures are most and least likely to influence indicator outcomes e.g. marked reductions in the Northern Celtic Seas versus modest changes in North Sea sub-regions in this case study. This information can support identification of where additional spatial or alternative (non-spatial) measures may be required. Additionally, if specific site-level details of spatial protection measures are uncertain during Programme of Measures development, the method could be used to define minimum spatial footprints necessary to plausibly achieve percentage-based thresholds for GES. As further evidence on displacement dynamics becomes available, future analyses could incorporate displacement into contribution assessments.

5.10 While this study focused on MPAs and SACs as spatial protection measures, other interventions and marine activities can also modify fisheries spatial patterns. In the Scottish context, the development of offshore wind is expected to drive substantial changes in spatial fisheries activity in the coming years [14]. Such changes have the potential to influence regional-scale physical disturbance levels and, consequently, the achievement of GES. Offshore wind license areas in Scotland are spatially defined well in advance of development, and there is a growing evidence base on their effects on fishing patterns. This suggests that the potential contribution of offshore wind developments to physical disturbance targets could also be assessed using the method described here. Furthermore, the same contribution-style approach could be extended, albeit with greater complexity, to non-spatial measures that modify fishing gear characteristics, temporal effort patterns, or fleet composition. Such extensions would need to incorporate explicit treatment of fleet behaviour, cross-jurisdictional effort redistribution, and likely technological change. They would, therefore, be more data and model-intensive but would expand the utility of contribution assessments for a Programme of Measures.

5.11 Overall, the method set out in this paper, if used with appropriate caveats and sensitivity testing, can substantially improve the evidence base for the development and subsequent scrutiny of measures under the UK Marine Strategy, and provide a

more robust assurance case on the sufficiency of measures to achieving GES. Environmental Standards Scotland intends to use the results of this analysis as part of its wider evidence base to support scrutiny of how effectively Scottish Ministers and other public authorities are fulfilling their duties under The Regulations.

6. Supplementary Material

6.1 Protected Areas

Table 8 Protected Areas included in analysis

Site	Type
Loch Sunart to the Sound of Jura	Marine Protected Area
Wester Ross	Marine Protected Area
Mousa to Boddam	Marine Protected Area
Shiant East Bank	Marine Protected Area
Loch Sunart	Marine Protected Area
North-east Lewis	Marine Protected Area
Clyde Sea Sill	Marine Protected Area
Small Isles	Marine Protected Area
Sea of the Hebrides	Marine Protected Area
Lochs Duich, Long and Alsh	Marine Protected Area
Loch Carron	Marine Protected Area
Fetlar to Haroldswick	Marine Protected Area
Papa Westray	Marine Protected Area
Loch Sween	Marine Protected Area
Monach Isles	Marine Protected Area
Loch Creran	Marine Protected Area
Noss Head	Marine Protected Area
Wyre and Rousay Sounds	Marine Protected Area
Southern Trench	Marine Protected Area
East Caithness Cliffs	Marine Protected Area
South Arran	Marine Protected Area
Upper Loch Fyne and Loch Goil	Marine Protected Area
West of Scotland	Marine Protected Area
Central Fladen	Marine Protected Area
Turbot Bank	Marine Protected Area
West Shetland Shelf	Marine Protected Area
Hatton-Rockall Basin	Marine Protected Area
North-west Orkney	Marine Protected Area
Norwegian Boundary Sediment Plain	Marine Protected Area
Firth of Forth Banks Complex	Marine Protected Area
East of Gannet and Montrose Fields	Marine Protected Area
North-east Faroe-Shetland Channel	Marine Protected Area
Faroe-Shetland Sponge Belt	Marine Protected Area
The Barra Fan and Hebrides Terrace Seamount	Marine Protected Area

Geikie Slide and Hebridean Slope	Marine Protected Area
Eileanan agus Sgeiran Lios mor	Special Area of Conservation
Loch nam Madadh	Special Area of Conservation
Hascosay	Special Area of Conservation
Rum	Special Area of Conservation
Sunart	Special Area of Conservation
East Mingulay	Special Area of Conservation
Loch Creran	Special Area of Conservation
Loch Laxford	Special Area of Conservation
Loch of Stenness	Special Area of Conservation
Firth of Lorn	Special Area of Conservation
Firth of Tay and Eden Estuary	Special Area of Conservation
Faray and Holm of Faray	Special Area of Conservation
Kinloch and Kyleakin Hills	Special Area of Conservation
Durness	Special Area of Conservation
Berwickshire and North Northumberland Coast	Special Area of Conservation
Luce Bay and Sands	Special Area of Conservation
Taynish and Knapdale Woods	Special Area of Conservation
Tayvallich Juniper and Coast	Special Area of Conservation
Glen Beasdale	Special Area of Conservation
Loch Moidart and Loch Shiel Woods	Special Area of Conservation
Yell Sound Coast	Special Area of Conservation
Inner Hebrides and the Minches	Special Area of Conservation
Sound of Barra	Special Area of Conservation
Loch Roag Lagoons	Special Area of Conservation
Lochs Duich, Long and Alsh Reefs	Special Area of Conservation
Sound of Arisaig (Loch Ailort to Loch Ceann Traigh)	Special Area of Conservation
South Uist Machair	Special Area of Conservation
South-East Islay Skerries	Special Area of Conservation
St Kilda	Special Area of Conservation
Ardvar and Loch a' Mhuilinn Woodlands	Special Area of Conservation
Ascrib, Isay and Dunvegan	Special Area of Conservation
Dornoch Firth and Morrich More	Special Area of Conservation
Inverpolly	Special Area of Conservation
Mull Oakwoods	Special Area of Conservation
Sanday	Special Area of Conservation
Solway Firth	Special Area of Conservation
Braemar Pockmarks	Special Area of Conservation
Scanner Pockmark	Special Area of Conservation
Obain Loch Euphoirt	Special Area of Conservation
Papa Stour	Special Area of Conservation
Isle of May	Special Area of Conservation

Treshnish Isles	Special Area of Conservation
North Rona	Special Area of Conservation
Monach Islands	Special Area of Conservation
Moray Firth	Special Area of Conservation
The Vadills	Special Area of Conservation
Moine Mhor	Special Area of Conservation
Mousa	Special Area of Conservation
Sullom Voe	Special Area of Conservation
Anton Dohrn Seamount	Special Area of Conservation
Darwin Mounds	Special Area of Conservation
East Rockall Bank	Special Area of Conservation
Hatton Bank	Special Area of Conservation
North West Rockall Bank	Special Area of Conservation
Pobie Bank Reef	Special Area of Conservation
Solan Bank Reef	Special Area of Conservation
Stanton Banks	Special Area of Conservation
Wyville Thomson Ridge	Special Area of Conservation

6.2 OSPAR QSR Broad-Scale Habitats which are not present in UK 2025 Part One Assessment

Circalittoral Seabed, Circalittoral Sediment, Infralittoral Seabed, Infralittoral Sediment, Lower bathyal Coarse sediment, Lower bathyal Mixed sediment, Lower bathyal Seabed, Lower bathyal Mud, Lower bathyal sand, Offshore circalittoral Seabed, Offshore circalittoral sediment, Upper bathyal Coarse sediment, Upper bathyal mixed sediment, Upper bathyal mud, Upper bathyal sand, Upper bathyal seabed.

6.3 Validation results

Table 9 Comparison of original OSPAR 2023 region calculations - % of area at risk of being subject to each category of disturbance – with ESS calculations for calibration. No input values changed by ESS, takes account of full OSPAR assessment units. Northern Celtic Sea (NCS) and Central North Sea (CNS).

Disturbance category	OSPAR 2023 original values (% of NCS area)	ESS calculated values (%)	OSPAR original values (% of CNS area)	ESS calculated values (%)
High (8-9)	21	21	12	12
Moderate (5-7)	34	34	12	12
Low (1-4)	33	34	17	17
Zero	12	12	56	56
Unassessed Disturbance	<1	0	3	3

7. References

1. DEFRA. Marine Strategy Part One: UK Updated assessment and Good Environmental Status. In: Department for Environment FaRA, editor. 2025. p. 83.
2. DEFRA. Marine Strategy Part Three: UK programme of measures. In: Department for Environment FaRA, editor. 2015. p. 162.
3. DEFRA. Marine Strategy Part Three: UK programme of measures. In: Department for Environment FaRA, editor. 2025. p. 65.
4. European Commission. Programmes of measures under the Marine Strategy Framework Directive Recommendations for implementation and reporting. In: DG Environment, editor. Brussels2014. p. 51.
5. European Commission. Commission Staff Working Document Accompanying the document Report from the Commission to the European Parliament and the Council assessing Member States' programmes of measures under the Marine Strategy Framework Directive. In: DG Environment, editor. Brussels2018. p. 203.
6. Matear L, Vina-Herbon C, Woodcock K, Duncombe-Smith S, Smith A, Schmitt P, et al. Extent of physical disturbance to benthic habitats: fisheries with mobile bottom-contacting gears. London; 2023. Available from: <https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/phys-dist-habs-fisheries/>. Accessed 03 December 2025.
7. Vina-Herbon C, Meakings B, Carter A, Edwards D, Duncan G, Lillis H, et al. Extent of Physical damage to predominant seafloor habitats. UK Marine Online Assessment Tool 2018. Available from: <https://moat.cefas.co.uk/previous-assessments/2018-assessment/biodiversity-food-webs-and-marine-protected-areas/benthic-habitats/physical-damage/>. Accessed 04 April 2025.
8. Woodcock K, Matear L, Duncombe-Smith S, Vina-Herbon C. Extent of Physical Disturbance to Benthic Habitats: Fisheries with mobile bottom-contacting gears 2025. Available from: <https://moat.cefas.co.uk/biodiversity-food-webs-and-marine-protected-areas/benthic-habitats/extent-of-physical-disturbance-to-benthic-habitats-fishing-mobile-gears/>. Accessed 04 December 2025.

9. OSPAR. OSPAR Extent of Physical Disturbance to Benthic Habitats - Data Snapshot 2023. Available from:
https://odims.ospar.org/en/submissions/ospar_phys_dist_habs_dsnap_2023_06/. Accessed 18 December 2025.
10. ICES. OSPAR request on the production of spatial data layers of fishing intensity/pressure. In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, ospar.2021.11.; 2021. Available from:
<https://doi.org/10.17895/ices.advice.8297>. Accessed 01 February 2026.
11. Scottish Government. Marine Protected Area Network 2024 Report to the Scottish Parliament. Edinburgh: Scottish Government; 2024. p. 110.
12. Greenstreet SPR, Fraser HM, Piet GJ. Using MPAs to address regional-scale ecological objectives in the North Sea: modelling the effects of fishing effort displacement. *ICES Journal of Marine Science*. 2009;66(1):90-100.
13. Natural England. Displacement of fishing effort from Marine Protected Areas. Natural England Commissioned Report NECR241. 2017. Available from:
<https://publications.naturalengland.org.uk/publication/5674265573064704>. Accessed 23 February 2026.
14. Trifonova N, Scott BE, Watson SCL, Szostek C, Declerck M, Beaumont N. Fishing, offshore wind energy, climate change and marine spatial planning: Is it possible to plan for a best use of space? *Ecological Solutions and Evidence*. 2025;6(2):e70039.

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