Report under The Conservation of Habitats and Species Regulations 2017 (as amended), Regulation 9A

2019-2024

Conservation status assessment for the habitat:

H1180 - Submarine structures made by leaking gases

Wales

Cyfoeth Naturiol Cymru
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JNCC

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Important note - Please read

- The information in this document represents Wales Report under The Conservation of Habitats and Species Regulations 2017 (as amended), Regulation 9A, for the period 2019-2024.
- It is based on supporting information provided by Natural Resources Wales, which is documented separately.
- The Habitats Regulations reporting 2019-2024 Approach Document provides details on how this supporting information contributed to the UK Report and the fields that were completed for each parameter.
- Maps showing the distribution and range of the habitat are included.
- Explanatory notes (where provided) are included at the end. These provide additional audit trail information to that included within the assessments. Further underpinning explanatory notes are available in the related country reports.
- Some of the reporting fields have been left blank because either: (i) there was insufficient information to complete the field; (ii) completion of the field was not obligatory; and/or (iii) the field was not relevant to this habitat (section 11 National Site Network coverage for Annex I habitats).

Further details on the approach to the Habitats Regulations Reporting 2019-2024 are available on the JNCC website.

Assessment Summary: Submarine structures made by leaking gases

Distribution Map

Range Map

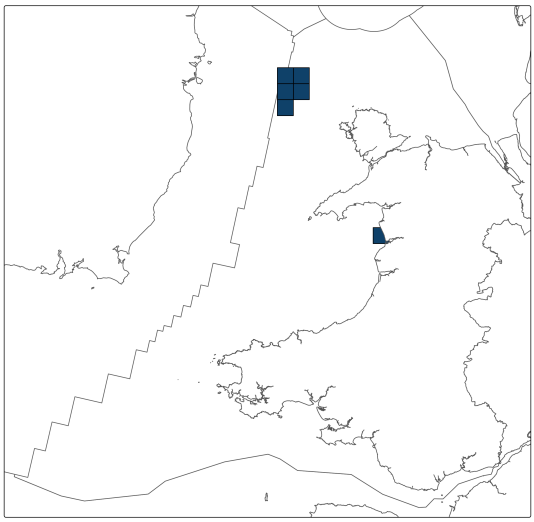

Figure 1: Wales distribution and range map for H1180 - Submarine structures made by leaking gases. Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority. The 10km grid square distribution map is based on available habitat records which are considered to be representative of the distribution within the current reporting period.

The range map was developed from the distribution map, but additionally included areas that had the potential for the habitat to occur based on an understanding of seabed geology.

Table 1: Table summarising the conservation status for H1180 - Submarine structures made by leaking gases. Overall conservation status for habitat is based on assessments of range, area covered by habitat, structure and functions, and future prospects.

Overall Conservation Status (see section 10)

Unknown (XX)

Breakdown of Overall Conservation Status

Range (see section 4)	**Unknown (XX)**
Area covered by habitat (see section 5)	**Unknown (XX)**
Structure and functions (see section 6)	**Favourable (FV)**
Future prospects (see section 9)	**Unknown (XX)**

List of Sections

National Level

1. General information

1.1 Country	Wales
1.2 Habitat code	H1180 - Submarine structures made by leaking gases

2. Maps

2.1 Year or period	2004-2024
2.2 Distribution map	Yes
2.3 Distribution map; Method used	Based mainly on extrapolation from a limited amount of data

2.4 Additional information

No additional information

Biogeographical Level

3. Biogeographical and marine regions

3.1 Biogeographical or marine region where the habitat occurs MATL

3.2 Sources of information

See section 13 References

4. Range

4.1 Surface area (km²)	58.064
4.2 Short-term trend; Period	2013-2024
4.3 Short-term trend; Direction	Stable
4.4 Short-term trend; Magnitude	

a) Estimated minimum	
b) Estimated maximum	
c) Pre-defined range	
d) Unknown	
e) Type of estimate	
f) Rate of decrease	
4.5 Short-term trend; Method used	Based mainly on extrapolation from a limited amount of data
4.6 Long-term trend; Period	
4.7 Long-term trend; Direction	
4.8 Long-term trend; Magnitude	
a) Minimum	
b) Maximum	
c) Rate of decrease	
4.9 Long-term trend; Method used	

4.10 Favourable Reference Range (FRR)

a) Area (km²)	
b) Pre-defined increment	
c) Unknown	Yes
d) Method used	
e) Quality of information	

4.11 Change and reason for change in surface area of range

a) Change	No
b) Genuine change	
c) Improved knowledge or more accurate data	

d) Different method	
e) No information	
f) Other reason	
g) Main reason	

4.12 Additional information

Best single value (where possible)=

58.064 km2 (Inshore and offshore area total)

min = (0.036+58) 58.036km2

max=Unknown

Inshore:

min = 0.036 km2 (4 confirmed areas of Holden's Reef

max= 0.087 km2(All areas identified (confirmed and un confirmed) from side scan)

Best single value= 0.036 km2

Offshore:

min = 58 km2(JNCC, 2024)

max=Unknown

Best single value= 58km2(JNCC, 2024)

5. Area covered by habitat

5.1 Year or period	2004-2022
5.2 Surface area (km²)	
a) Minimum	
b) Maximum	
c) Best single value	58.115
5.3 Type of estimate	Minimum
5.4 Surface area; Method used	Based mainly on extrapolation from a limited amount of data
5.5 Short-term trend; Period	2013-2024

5.6 Short-term trend; Direction	Stable
5.7 Short-term trend; Magnitude	
a) Estimated minimum	
b) Estimated maximum	
c) Pre-defined range	
d) Unknown	
e) Type of estimate	
f) Rate of decrease	
5.8 Short-term trend; Method used	Based mainly on extrapolation from a limited amount of data
5.9 Long-term trend; Period	
5.10 Long-term trend; Direction	Unknown
5.11 Long-term trend; Magnitude	
a) Minimum	
b) Maximum	
c) Confidence interval	
d) Rate of decrease	
5.12 Long-term trend; Method used	Insufficient or no data available
5.13 Favourable Reference Area (FRA)	
a) Area (km^2)	
b) Pre-defined increment	
c) Unknown	Yes
d) Method used	
e) Quality of information	

5.14 Change and reason for change in surface area of range

a) Change	No
b) Genuine change	
c) Improved knowledge or more accurate data	
d) Different method	
e) No information	
f) Other reason	
g) Main reason	

5.15 Additional information

Best single value (where possible)=

58.064 km2 (Inshore and offshore area total)

min = (0.036+58) 58.036km2

max=Unknown

Inshore:

min = 0.036 km2 (4 confirmed areas of Holden's Reef)

max= 0.087 km2 (All areas identified (confirmed and un confirmed) from side scan)

Best single value= 0.036 km2

Offshore:

min = 58 km2(JNCC, 2024)

max=Unknown

Best single value= 58km2(JNCC, 2024)

6. Structure and functions

6.1 Condition of habitat (km²)

Area in good condition

ai) Minimum	58.036
aii) Maximum	58.87
Area not in good condition	

bi) Minimum	0
bii) Maximum	0
Area where condition is unknown	
ci) Minimum	0
cii) Maximum	0
6.2 Condition of habitat; Method used	Based mainly on expert opinion with very limited data
6.3 Short-term trend of habitat area in good condition; Period	2013-2024
6.4 Short-term trend of habitat area in good condition; Direction	Stable
6.5 Short-term trend of habitat area in good condition; Method used	Based mainly on expert opinion with very limited data

6.6 Typical species

Has the list of typical species changed in comparison to the previous reporting period?	No

6.7 Typical species; Method used

6.8 Additional information

Typical species were not used directly in the assessment of conservation status for habitat structure and function as a comprehensive list of typical species for each habitat was not available. However, the status of typical species was considered when the condition of individual sites was assessed using Common Standards Monitoring Guidance. Common Standards Monitoring (CSM) data was used to assess the area of habitat in ‘good’ and ‘not good’ condition (field 6.1). Species were a component of the attributes assessed under CSM. Therefore, an assessment of species is considered to have formed part of the reporting under field 6.1 which supported the Habitats Structure and Function assessment (field 10.3).

7. Main pressures

7.1 Characterisation of pressures

Table 2: Pressures affecting the habitat, including timing and importance/impact ranking. Pressures are defined as factors acting currently and/or during the reporting period (2019–2024). Rankings are: High (direct/immediate influence and/or large spatial extent) and Medium (moderate direct/immediate influence, mainly indirect and/or regional extent).

Pressure	Timing	Ranking
PG03: Marine fish and shellfish harvesting activities causing physical loss and disturbance of seafloor habitats	Ongoing and likely to be in the future	High (H)
PJ01: Temperature changes and extremes due to climate change	Ongoing and likely to be in the future	Medium (M)
PJ10: Change of habitat location, size, and / or quality due to climate change	Only in future	Medium (M)
PJ11: Desynchronisation of biological / ecological processes due to climate change	Only in future	Medium (M)
PJ12: Decline or extinction of related species (e.g. food source / prey, predator / parasite, symbiote, etc.) due to climate change	Only in future	Medium (M)
PJ13: Change of species distribution (natural newcomers) due to climate change	Ongoing and likely to be in the future	Medium (M)

7.2 Sources of information

See section 13 References

7.3 Additional information

No additional information

8. Conservation measures

8.1: Status of measures

a) Are measures needed?	Yes
b) Indicate the status of measures	Measures identified and taken

8.2 Main purpose of the measures taken	Maintain the current range, surface area or structure and functions of the habitat type
8.3 Location of the measures taken	Both inside and outside National Site Network
8.4 Response to measures	Long-term results (after 2036)

8.5 List of main conservation measures

Table 3: Key conservation measures addressing current pressures and/or anticipated threats during the next two reporting periods (2025–2036). Measures are ranked by importance/impact: High (direct/immediate influence and/or large spatial extent) and Medium (moderate direct/immediate influence, mainly indirect and/or regional extent).

Conservation measure	Ranking
MG01: Management of professional/commercial fishing, shellfish and seaweed harvesting (incl. restoration of habitats)	Medium (M)
MJ01: Implement climate change mitigation measures	Medium (M)
MF06: Reduce/eliminate marine pollution from industrial, commercial, residential and recreational areas and activities (incl. contamination with litter)	Medium (M)

8.6 Additional information

Only part of the measures identified have been taken.

9. Future prospects

9.1a Future trends of parameters

ai) Range	Unknown
bi) Area	Unknown
ci) Structure and functions	Unknown

9.1b Future prospects of parameters

aii) Range	Unknown
bii) Area	Unknown

cii) Structure and functions	Unknown

9.2 Additional information

No additional information

10. Conclusions

10.1 Range	Unknown (XX)
10.2 Area	Unknown (XX)
10.3 Specific structure and functions (incl. typical species)	Favourable (FV)
10.4 Future prospects	Unknown (XX)
10.5 Overall assessment of Conservation Status	Unknown (XX)
10.6 Overall trend in Conservation Status	

10.7 Change and reason for change in conservation status

This field is not reported as the period 2019-2024 marks the first instance in which conservation status has been assessed at the national level, meaning no comparisons to previous reports can be drawn.

10.7 Change and reason for change in conservation status trend

This field is not reported as the period 2019-2024 marks the first instance in which conservation status has been assessed at the national level, meaning no comparisons to previous reports can be drawn.

10.8 Additional information

No additional information

11. UK National Site Network (pSCIs, SCIs, SACs) coverage for Annex I habitat types

11.1 Surface area of the habitat type inside the pSCIs, SCIs and SACs network (km²)

a) Minimum	56.736
b) Maximum	
c) Best single value	56.736
11.2 Type of estimate	Minimum
11.3 Habitat area inside the network; Method used	Based mainly on extrapolation from a limited amount of data
11.4 Short-term trend of habitat area within the network; Direction	Stable
11.5 Short-term trend of habitat area within the network; Method used	Based mainly on expert opinion with very limited data
11.6 Short-term trend of habitat area in good condition within the network; Direction	Stable
11.7 Short-term trend of habitat area in good condition within the network; Method used	Based mainly on extrapolation from a limited amount of data

11.8 Additional information

The total extent of Annex I habitat for which features have been designated (Grades A-C) in Wales offshore SACs (offshore waters only) is 56.7km²

12. Complementary information

12.1 Justification of percentage thresholds for trends

No justification information

12.2 Other relevant information

No other relevant information

13. References

Biogeographical and marine regions

3.2 Sources of information

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Main pressures

7.2 Sources of information

No sources of information

14. Explanatory Notes

Field label	Note
2.3: Distribution map; Method used	The 10km square distribution and habitat area estimates are derived from a combination of different original sources, summarised below. A single updated aggregated GIS layer has been created for this habitat across Wales joining together the maps and records from the other listed sources. Data Source 1 Inshore map from Side scan sonar 2022 (NRW, 2022b) Data Source 2: Offshore map from Croker Slabs survey in 2015 (NobleJames et al., 2017) Inshore: The inshore areas of MDAC were initially surveyed as part of the SEA6 project using multibeam echo sounder (MBES) and sidescan sonar. Since then, a section of the reef, known as Holden's Reef, has been monitored regularly, with its extent measured by scuba divers over several years. From 2014 onwards, sidescan sonar surveys have been conducted regularly to assess changes in its distribution. However, the survey area remains limited to the boundaries of the original SEA6 survey. The inshore areas identified in the vicinity of Holden's Reef account for just 0.15% of the Welsh resources of submarine structures made by leaking gases. Within this area, four confirmed MDAC reefs have been identified, alongside numerous smaller, less-developed patches. These additional features have not been directly ground-truthed but are presumed to be submarine structures associated with gas seepage. Although the inshore area is such a small component of the Welsh resource it is important because it is unique in the UK

	because of its shallow nature within the photic zone. Offshore: Croker Carbonate Slabs SAC is the largest known example of the feature in the UK and assessed as being in favourable condition in the previous reporting round (JNCC, 2018b). The offshore reef accounts for 99.85% of the Welsh resources of submarine structures made by leaking gases. A multibeam survey in 2015 (Noble James et al., 2017) showed evidence that the seep is still active and that Methane-Derived Authigenic Carbonate (MDAC) is still likely to be forming. There have not been any follow up monitoring surveys since and so the area of the offshore element is largely unknown.
4.1: Surface area	Best single value (where possible)= 58.064 km2 (Inshore and offshore area total) min = (0.036+58) 58.036km2 max=Unknown Inshore: min = 0.036 km2 (4 confirmed areas of Holden's Reef max= 0.087 km2(All areas identified (confirmed and un confirmed) from side scan) Best single value= 0.036 km2 Offshore: min = 58 km2(JNCC, 2024) max=Unknown Best single value= 58km2(JNCC, 2024)

4.3: Short-term trend; Direction	Range for this feature is based on the actual polygon area and not the 10km grid square distribution map. In 2019 a UK range map was developed from the UK distribution map, but additionally included areas that had the potential for the habitat to occur based on an understanding of seabed geology (JNCC, 2016; JNCC, 2018a). As described in Statement on the habitat in Wales, Submarine structures rely on leaking gases and so a fundamental requirement for the formation of these structures is the presence of methane (Judd, 2005). There is insufficient data on the habitat to determine its true range, due to the practical difficulties in detecting MDAC remotely. Nevertheless, it is possible to identify sites at which MDAC is likely to occur by identifying 'shallow gas' (gas in the sediments close to the seabed), gas seeps, and seabed features associated with gas seepage (pockmarks, mud volcanoes etc.) (Judd, 2005; Judd et al., 2007). Therefore, a range map has been produced showing these areas within which the Annex I habitat may occur. The value given is the estimated potential range over which MDAC could occur. Consequently, figures represent potential habitat range and there are no real trend data from which to determine any change in the range of this habitat. Although fishing pressure has been highlighted as High in Section 7, there is thought to be only a limited amount of mobile fishing activity on the reef itself and the level of static gear fishing is unknown. Although these activities have potential for causing deterioration of the reef, impact towards the extent of this feature since the previous survey is likely to be minimal, therefore the extent of this feature are considered stable. For further details see 2019 UK Approach Document on the JNCC website. Inshore, the range area is derived from NRW's side scan

	monitoring data, the most recent of which was collected in 2022.
4.10: Favourable Reference Range (FRR)	FRV-Unknown - Since the range of the feature is primarily dependent on geological processes the actual range is likely to be equivalent to the favourable reference range. However, in the absence of both a true range estimate and trend data, it is not appropriate to report a favourable reference range estimate for this reporting period.
5.2: Surface area	Best single value (where possible)= 58.064 km2 (Inshore and offshore area total) min = (0.036+58) 58.036km2 max=Unknown Inshore: min = 0.036 km2 (4 confirmed areas of Holden's Reef) max= 0.087 km2 (All areas identified (confirmed and un confirmed) from side scan) Best single value= 0.036 km2 Offshore: min = 58 km2(JNCC, 2024) max=Unknown Best single value= 58km2(JNCC, 2024) For narrative, see Section 2.3
5.3: Type of estimate	Inshore: Best estimate Offshore: Minimum

5.6: Short-term trend; Direction	Although fishing pressure has been highlighted as High in Section 7, there is thought to be only a limited amount of mobile fishing activity on the reef itself and the level of static gear fishing is unknown. Although these activities have potential for causing deterioration of the reef, impact towards the extent of this feature since the previous survey is likely to be minimal, therefore the extent of this feature are considered stable.
5.9: Long-term trend; Period	Inshore 2004 – 2022 The area of the four main reef reefs at the Holden's reef site all remain similar in area to when they were first surveyed in the SEA6 Survey. Offshore 2000-present: Unknown (Insufficient data)
5.10: Long-term trend; Direction	Inshore: Stable Offshore: Only short term data available so Unknown
5.12: Long-term trend; Method used	Inshore: b) Based mainly on extrapolation from a limited amount of data Offshore: d) Insufficient or no data available
6.1: Condition of habitat	Inshore: a) Area in good condition 0.036-0.87 km2 b) Area in not-good condition min - max km2 c) Area where condition is not known min - max km2 Offshore

a) Area in good condition

58. km2

b) Area in not-good condition

min - max km2

c) Area where condition is not known

min - max km2

Overall:

a) Area in good condition

58.036 – 58.87 km2

b) Area in not-good condition

min - max km2

c) Area where condition is not known

min - max km2

Inshore:

100% of inshore reef structure falls within the Pen Llyn a'r Sarnau SAC. This inshore reef is monitored regularly as part of NRW's dive monitoring programme, side scan sonar monitoring and also falls within a WFD coastal water body.

The information gathered through these surveys have been analysed, interpreted and reported through NRW's reef condition assessment process (Jackson-Bué et al, 2025). Data derived from surveys undertaken by divers has shown that there is no significant changes in the reef's rugosity.

This is an important indicator of the reef's structural integrity. The formation process of MDAC reef's produces a complex three-dimensional habitat with chimneys, holes and ledges and overhangs that provide niches habitats for a wide variety of marine organisms, invertebrates and fish to live in. Another primary indicator of the Condition Assessment is to maintain the abundance, distribution, and diversity of species within communities and component habitats, allowing for natural change and variation. The assessment has also shown there to be no significant change in the fish population utilising the reef. However, there was a small decline in the fish diversity and species richness in the shallow zone at the North transect at Holden's Reef, but this was attributed to natural variation. There are no specific records of Invasive Non Native Species (INNS) at Holden's reef. However the slipper limpet Crepidula fornicata has been recorded in this reporting round within Pen Llŷn a'r Sarnau.

WFD Interim Cycle 3 Assessment

Holden's reef is situated within the Cardigan Bay North Waterbody which has been classified with a Moderate status for chemicals in the WFD interim Cycle 3 assessment. It failed for mercury and polybrominated diphenyl ethers (PBDEs). These failures remain unchanged from the baseline Cycle 3 assessment. There is evidence that mercury and PBDEs can have a negative effect on microbial communities in marine sediments. Further information provided in Section 7 Pressures.

Given that many water bodies fail chemical status due to ubiquitous, persistent, bioaccumulative, and toxic (uPBT) substances, ongoing monitoring and management remain essential to safeguard MDAC reefs and their ecological functions.

NRW has carried out a WFD Investigation of PBDEs levels in the Cardigan Bay North Waterbody which confirmed the

failure and identified the reasons for Not Achieving Good (RNAGs) as:

1. Diffuse source, contaminated water body bed sediments, from industry, manufacturing and other business with major apportionment and probable certainty

2. Point source, sewage discharge (continuous), water industry, with major apportionment and probable certainty

An investigation of mercury levels has also been carried out and confirmed the failure as genuine but a Stage 2 investigation to identify the RNAGs has not yet been carried out.

Offshore:

More than 99% of the offshore reef structures fall within Croker Carbonate Slabs SAC. This is the largest known example of the feature in the UK . The 'Condition of the habitat" reported here is derived from condition assessments which class Croker carbonate slabs in Favourable condition (JNCC, 2018b, 2025). A survey in 2015 (Noble James et al., 2017) showed evidence that the seep is still active and that Methane-Derived Authigenic Carbonate (MDAC) is still likely to be forming. Patches of thiotrophic bacterial mats, Beggiotoa sp. were observed. Fauna typical of hard substrates were observed at the site and multivariate analyses identified five epifaunal taxa that were typically associated with the MDAC feature and occurred more frequently in areas of the 'outcropping' form of the feature. These were (the soft coral Alcyonium digitatum, the hydroids Nemertesia spp. and Tubularia spp., the bryozoan Cellaria spp. and the polychaete family Sabellidae spp.).

However, the monitoring programme is in the initial stages and time-series data are not yet available. There is no recent data to show any changes in reef area or condition

	of the habitat but the opinion is that there will not have been a significant change since the last survey and previous assessment (JNCC, 2025). Croker is targeted by static bottom-contacting gear (Wood et al, 2016) and the potential for damage is there but can't be assessed. This is mainly due to the limitations of VMS data in that it cannot tell us how many pots are deployed and for how long. Equally there isn't a good understanding of impacts from repeated exposure to pressures from static gear.
6.2: Condition of habitat; Method used	Inshore:b) Based mainly on extrapolation from a limited amount of data Offshore: c) Based mainly on expert opinion with very limited data
6.5: Short-term trend of habitat area in good condition; Method used	Inshore:b) Based mainly on extrapolation from a limited amount of data Offshore: c) Based mainly on expert opinion with very limited data
7.1: Characterisation of pressures	The scoring in table 7.1 has been provided by JNCC for the offshore area. Croker Carbonate Slabs SAC accounts for more than 99% of the Welsh resource and so their scores have been reported overall. The narrative below identifies differences for the inshore area. MDAC reef is a complex 3D structure and is relatively fragile when compared to geologically formed reef. The results of the MDAC dating analysis (as discussed by Judd et al., 2020) suggest that MDAC formation is extremely slow (in human terms) and subsequently the MDAC has been assessed as highly sensitive to physical loss, physical change, removal of substratum, and abrasion/disturbance

of the surface of the substratum (Tyler-Walters, 2018).

Offshore structures

For offshore submarine structures made by leaking gases, the pressures and threats have remained the same since 2019, however fishing pressure has increased and two climate change threats are now considered ongoing pressures. The OSPAR thematic assessment of benthic habitats (OSPAR, 2023a) highlights that benthic habitats are impacted by activities operating and/or interacting with the biotic and abiotic components of the seafloor. Key pressures include shipping, fish and shellfish harvesting, extraction of minerals, tourism and leisure, renewable energy, submarine cables, oil and gas, agriculture, aquaculture and climate change causing physical disturbance, physical loss, and alterations to biological communities. Offshore submarine structures are likely to be exposed to marine pollution from oil and gas operations and spillages and release from shipping, however the impact of these has been ranked as low. Key pressures for Submarine Structures made by leaking gases include:

PG03:

Fishing activity has increased in the Celtic Seas. This pressure is ranked high due to the sensitivity of this habitat to the effects of demersal trawling and fishing causing physical disturbance and physical loss, and the spatial overlap of >25% identified from human activity layers. The trend until 2030 is uncertain (OSPAR, 2023).

Fishing pressures resulting in the removal of target and non-target species refer to any damage, loss or removal of species defined as a designated feature, or species integral to the integrity of a designated feature (for example key structural or influential species). As details of key structural and influential species for offshore submarine structures are yet to be fully defined, they are assessed more

completely within the surface and subsurface abrasion pressures meaning PG01 is covered by this pressure/threat code.

ICES data (2021) and Global Fishing Watch indicate there to be a low pressure of demersal mobile fishing activity and a 100% overlap with Croker Carbonate Slabs SAC. However, the resolution of the C Square data is coarse and fishermen are likely to be targeting sediment habitat adjacent to the reef for fear of snagging and losing gear.

Fishing activities, particularly the use of demersal towed gears, pose a significant risk to MDAC reef structures through physical disturbance and abrasion to the biological communities (JNCC & NE, 2011; Walmsley et al., 2015). Seffel (2010) reported that 'fishing equipment like bottom trawling nets are known to tear pieces off the carbonate structures'. The negative effects of demersal fishing on this habitat is well documented by Marlin (Tyler-Walters, 2018a, b), MarESA (Marine Evidence based Sensitivity Assessment) and the Assessing Welsh Fishing Activities (AWFA) Project.

Additionally, the offshore Croker Carbonate Slabs SAC, is subject to static pot fishing. (Wood et al, 2016). While shellfish potting is generally considered a lower-impact activity, the deployment and recovery of pots can also cause damage on such structures. Where pots are fixed in strings, the retrieval of pots, or incidences of rough weather, could lead to ropes, pots and anchors dragging over or entangling carbonate reef structures, potentially causing physical damage or abrasion to the biological communities (MacDonald et al., 1996; Roberts et al., 2010; JNCC & NE, 2011, Gall, 2020). Additionally, during spring tides, strong wind and large waves may cause unintentional movement of pots and any associated carbonate reef abrasion could be increased (Eno et al., 2001; Sørensen et al., 2015; Stephenson et al., 2015).

Please refer to the MarLIN website which provides further information about the assessment methodology and supporting evidence (www.marlin.ac.uk/).

PJ10, PJ11, PJ12: Climate change and ocean acidification cause direct and indirect pressures which can significantly alter the environmental conditions (e.g. decreases in pH, increases in sea surface temperature) necessary for benthic ecosystem processes and functions (OSPAR, 2023). Calcifying organisms are thought to be vulnerable to ocean acidification under climate change, with some models predicting up to 13% of cold water coral reefs being in low-aragonite areas (Hoppit & Schmidt 2022, Moore & Smale 2020). Climatic models predict there will be changes to area of suitable habitat in the future depending on the climatic scenario (Moore & Smale, 2020). Other studies suggest ecosystem-level responses could remain stable over long periods of time, depending on the species involved (Moore & Smale, 2020). While confidence in evidence has increased from low to medium, there are still knowledge gaps meaning we are unable to fully assess the scale of benthic species and community responses in relation to climate change for broadscale habitats (Moore & Smale, 2020).

PJ01, PJ13: The timing of these pressures are now considered ongoing now and in the future due to evidence to suggest temperature changes and extremes and changes in species distributions due to climate change is already occurring. Confidence in available evidence has increased from low to medium (Moore & Smale, 2020). Benthic habitats are predicted to face increased temperatures and frequency of heatwaves under climatic projections in the future. Offshore circalittoral rocks are thought to face a strong effect of increased temperatures in the future (OSPAR, 2023). Benthic invertebrates and macroalgal species distributions and range shifts of local

species, with some increase in warm-water affinity species especially in the South-West.

Inshore:

PG03 Marine fish and shellfish harvesting activities causing physical loss and disturbance of seafloor habitats (Medium - ongoing and likely to be in the future)

The inshore Holden's reef area within Pen Llyn a'r Sarnau SAC (<1% of the Welsh resource) is thought to only be fished with static gear for crab/lobster. All demersal fishing with dredges is banned within Pen Llyn a'r Sarnau SAC. There is potential for interactions with light otter trawl as there are no restrictions, though this is currently thought to be unlikely. NRW's dive monitoring programme which includes a rugosity assessment at Holden's Reef has not found there to be a decline in the reef. However, the hauling of pots has been witnessed by divers in situ and surface abrasion and scraping of epifauna was evident (Ramsay and Lindenbaum pers comm. March 2025).

PJ01: Temperature changes and extremes due to climate change (Medium 4)

PJ06: Wave exposure changes due to climate change (Low 4)

PJ10: Change of habitat location, size, and / or quality due to climate change (Medium 4)

PJ14: Other climate related changes in abiotic conditions (ocean acidification) (Low 4)

We are currently unable to fully assess the scale of benthic species and community responses in relation to climate change, understand how climate interacts with other marine stressors or model future species distributions for many benthic species. An appropriate benthic monitoring

programme, coupled with continued involvement in international initiatives, is essential for characterising climate impacts on UK benthos' (Birchenough et al., 2013).

Increased wave exposure as a result of climate change will disproportionally effect the shallow (6-15m) inshore Holden's Reef. An increase in wave exposure would likely result in physical damage to the fragile 3d structure.

Although significant increases in water temperature have not been observed in PLAS SAC over the monitoring period, Cardigan Bay experiences some of the warmest coastal waters in the UK. Additional increases in surface seawater temperature due to climate change are likely to affect community composition at Holden's Reef as certain species tolerances are exceeded.

In a study by Oaten et al (2021) component biotopes of submarine structures made by leaking gases within Pen Llyn a'r Sarnau SAC were mostly assessed (84% of the inshore area) as medium vulnerability to increases in sea temperature with 16% of the inshore area assessed as high.

It should also be noted that the joint effects of ocean acidification (Intergovernmental Panel on Climate Change (IPCC), 2014) and the production of hydrogen sulphide by anaerobic oxidation of methane (Judd & Hovland, 2007) could create conditions accelerating the erosion of MDAC, and therefore pH measurements at the seabed would be a valuable addition to future monitoring surveys.

PK02: Mixed source marine water pollution (marine and coastal) (Low – ongoing and likely to be in the future)

In the WFD Cycle 3 (2021) classification, the Cardigan Bay North coastal waterbody (in which the inshore Holden's reef lies) had failures in the chemical classification for mercury and PBDE. As a result of these failures, the investigation

process was initiated. The first stage in this process is to establish that the failure in genuine and if its found to be, the investigation proceeds to Stage 2 in which the Reasons for Not Achieving Good (RNAG) status are established. The inshore reef is <1% of the total Welsh resource.

A Stage 1 Investigation has been completed for Mercury which has confirmed the failure to be legitimate. This investigation will proceed to the second stage but has not been completed yet.

Stage 1 and 2 investigations have been completed for PBDE. The RNAGs identified are:

3. Diffuse source, contaminated water body bed sediments, from industry, manufacturing and other business with major apportionment and probable certainty

4. Point source, sewage discharge (continuous), water industry, with major apportionment and probable certainty

Historically mercury, has been used in manufacturing industry, but sources now primarily originate from legacy coal and mining sites, leaching from contaminated sediments and soil. PBDEs, once widely used as flame retardants, were largely banned under the Stockholm Convention in 2004, with only limited use of decaBDE now allowed. The Environmental Quality Standard (EQS) for mercury is based on its risk of secondary poisoning in wildlife whereas the PBDE EQS is assessed under human health protection criteria.

Though direct impacts are uncertain, mercury could disrupt microbial communities essential for MDAC formation, affecting carbonate precipitation and reef stability. PBDEs, as persistent pollutants, may alter sediment microbial composition, potentially influencing biogeochemical processes critical to MDAC development.

	However, the effects of these contaminants on MDAC reefs remain unclear, and are only potentially affecting a small proportion of the Welsh resource so this has been ranked as a Low pressure. Since these WFD failures are current, this pressure has been assessed as 'ongoing and likely to be in the future'. Both mercury and PBDEs are actively managed, and their levels should decline over time.
8.1: Status of measures	Offshore (>99% Welsh resource) measures to reduce/ eliminate the potential damage caused by demersal fishing techniques such as trawling and dredging within the Croker Carbonate Slabs SAC have been identified but have not been taken. This feature is assessed as 'Favourable' within the Croker Carbonate Slabs SAC in offshore Welsh waters. At the time of assessment (2018), there was negligible overlap between the feature and pressures known to impact the feature. However, this does not preclude the need for additional management to safeguard the feature from any change in activity occurring in this site. Proposals for management were previously developed under the EU Joint Recommendation process for Croker Carbonate Slabs SAC. These measures aimed to exclude demersal trawls, dredges and seine nets to protect Annex I Submarine structures made by leaking gases feature within the sites management boundaries. These measures had not been agreed at the time of the UK's exit from the EU, and management of this site now falls under the remit of Welsh Ministers and the Secretary of State. Measures for this site have not progressed since the 2019 reporting round. Inshore: Measures relating to some of the pressures of diffuse pollution have been identified and taken but more is needed to understand the sources. Other measures relating to climate change have been identified, some of which have been taken.

	This is considered to be a low confidence assessment because the ability of some of these measures to fully address known and potential pressures and threats is uncertain and the time scale is also uncertain. The inshore area is only a small proportion (0.15%) of the Welsh resource
8.2: Main purpose of the measures taken	Conservation objectives for this feature within the MPAs where it is protected are mainly maintain or restore. The Conservation Advice for the Croker Carbonate Slabs SAC sets maintain objectives for all attributes. Pressures likely to impact these attributes which derive from fishing can be limited through the implementation of fisheries management areas where restrictions on gear apply.
8.3: Location of the measures taken	Through Environmental Impact Assessment, Habitats and Birds Directives, conservation measures will be implemented both inside and outside Natura 2000 sites; if features of conservation interest are identified during surveys for EIA outside Natura 2000 sites, they are still given consideration in terms of impact limitation and mitigation.
8.4: Response to the measures	MarESA (Marine Evidence based Sensitivity Assessment) indicates that the habitat is sensitive to the pressures caused by fishing including 'physical change to another seabed type', as well as surface and subsurface abrasion ('abrasion/disturbance of the surface of the substratum or seabed' and 'penetration or disturbance of the substratum subsurface'). The assessment suggests that the habitat has high sensitivity and very low resilience to the pressure 'physical change to another seabed type', this predicts negligible or prolonged recovery; at least 25 years to recover structure and function (Tyler-Walters, 2018a; Tyler-Walters, 2018b). Therefore, the response to measures, once implemented, is predicted to be long-term. The habitat has medium sensitivity to surface and subsurface abrasion, which suggests full recovery within 2 to 10 years (Tyler-Walters, 2018a; Tyler-Walters, 2018b).

8.5: List of main conservation measures	MG01: Management of professional/commercial fishing, shellfish and seaweed harvesting (incl. restoration of habitats) (M) Inshore there are commercial fishing legislation and byelaws restricting types of gear used. There is no scallop dredging permitted within the PLAS SAC (Scallop Fishing (Wales) (No.2) Order 2010 http://www.legislation.gov.uk/wsi/2010/269/made) and unlikely to be any otter trawl or other demersal fishing in the Holden's Reef area. There is an active shellfish potting fishery around Holdens Reef which is regulated through UK and Welsh Government fishery legislation. MDAC reef could be subject to damage through direct contact of pots and ropes as described above in Section 7 narrative. Offshore: PG03 (Marine fish and shellfish harvesting activities causing physical loss and disturbance of seafloor habitats) was ranked high in terms of both pressures and threats for Annex I habitats Submarine Structures made by Leaking Gases. While the feature Annex I habitats Submarine Structures made by Leaking Gases is currently assessed as maintain in the Croker Carbonate Slabs SAC, measures were previously considered to safeguard this feature under the Joint Recommendation process prior to EU exit and may be considered in future by the Welsh Ministers and Secretary of State. Additional info: Proposals for management were previously developed under the EU Joint Recommendation process for Croker Carbonate Slabs SAC. These measures aimed to exclude demersal trawls, dredges and seine nets to protect Annex I Submarine structures made by leaking gases feature within the sites management boundaries. These measures had

not been agreed at the time of the UK's exit from the EU, and management of this site now falls under the remit of Welsh Ministers and the Secretary of State. Measures for this site have not progresses since the 2019 reporting round.

MJ01: Implement climate change mitigation measures (M)

The UK, including Wales, has implemented various conservation measures to mitigate climate change impacts, focusing on carbon reduction, habitat restoration, and sustainable resource management.

One major initiative is the UK's net-zero by 2050 target, which Wales supports through its Net Zero Wales plan under the Environment (Wales) Act 2016. This includes decarbonising industries, investing in marine renewables like floating offshore wind farms in the Celtic Sea, and restoring natural carbon sinks (Welsh Government, 2021). There is growing focus on marine and coastal restoration of habitats such as salt marsh, seagrass and native oyster, all of which are important for blue carbon storage. A number of projects to restore these habitats right across Wales, and a further focus on restoration is supported by WG's Programme for Government commitment to put in place targeted programmes of restoration for sea grass and salt marsh.

Habitat conservation plays a crucial role in climate mitigation. Peatland restoration is a key focus in Wales, as peatlands store vast amounts of carbon. The National Peatland Action Programme aims to restore 600-800 hectares of peatland per year, with projects in Eryri (Snowdonia), Bannau Brycheiniog (Brecon Beacons), and the Cambrian Mountains (NRW, 2022). Similarly, the National Forest for Wales is expanding tree planting to improve carbon sequestration and biodiversity.

Wales is also reforming agriculture under the Sustainable

Farming Scheme, which rewards farmers for climate-friendly practices like soil conservation and agroforestry.

These conservation efforts, combined with emissions reduction policies, contribute to Wales' climate resilience strategy.

MF06: Reduce impact of mixed source pollution: (M)

Mercury is a naturally occurring metallic element, but much of the mercury found in the environment today arises from past industrial activity. In October 2013, the UK became a signatory to the Minamata Convention on mercury. This is a global treaty, which aims to protect human health and the environment from the adverse effects of mercury. In May 2017, the Minamata Convention was ratified and became legally binding for all its Parties (European Commission, 2017a). At the time the UK signed the Minamata Convention, most of the requirements were met by existing EU legislation. To address any gaps and enable ratification of the Minamata Convention, the Mercury Regulation (EU/852/2017) was adopted by EU Member States. The government's 25 Year Environment Plan sets out a commitment to reducing land-based emissions of mercury to air and water by 50% by 2030 as part of its overarching commitment to reducing the levels of harmful chemicals entering the environment. (Environment Agency, 2021)

River Basin Management Plans (RBMPs) and Programme of Measures (PoMs)

To further manage water pollution, including metal contamination, mercury, and PBDEs, Wales has implemented River Basin Management Plans (RBMPs) under the Water Framework Directive (WFD). These plans aim to improve the ecological and chemical status of Welsh water bodies through six-year management cycles, with the current plan running from 2021-2027 (NRW, 2023).

	The area discharging into the Cardigan Bay North Waterbody falls within the Western Wales River Basin District (RBD) and is overseen by NRW. These RBMPs set out environmental objectives and outline a Programme of Measures (PoMs), which include: • Regulatory Measures – Strengthening enforcement of environmental permits to limit pollutants. • Voluntary Initiatives – Encouraging best land and industrial practices to reduce pollution. • Targeted Remediation Projects – Restoring damaged water bodies, including those affected by metal mines. NRW's high-frequency monitoring projects, such as those in the Teifi catchment, are also helping to track pollutants in Welsh rivers, supporting data-driven interventions (NRW, 2024). By integrating metal mine remediation with river basin management strategies, Wales is tackling historical and emerging water quality challenges. The combination of active pollution treatment, targeted regulatory enforcement, and long-term planning ensures that North Wales' rivers, including those in Snowdonia, move towards achieving good ecological status under the WFD.
9.1:Future trends and prospects of parameters	This is unknown, mainly because there is only limited data (one comprehensive survey with no repeat) for the offshore Croker Carbonate Slabs SAC. Although the range, area and structure and function parameters for these are all thought to be stable, the FRV is unknown and there is insufficient data to assess the future prospects. There are a number of pressures that are known to have the potential to affect these parameters and whilst some conservation measures are in place to address these, their overall effectiveness is unknown. At the inshore Holden's Reef there are a number of

	pressures and threats that are known to have the potential to affect these parameters and whilst some conservation measures are in place to address these, their overall effectiveness is unknown. Due to insufficient information on the range, area and structure and functions parameters it is not possible to assess the future prospects for submarine structures made by leaking gases.
10.1: Range	Conclusion on Range reached because: (i) the short-term trend direction in Range surface area is stable; and (ii) the Favourable Reference Range is unknown.
10.2: Area	Conclusion on Area reached because:(i) the short-term trend direction in Area is stable; (ii) the Favourable Reference Area is unknown and iii) the change in distribution pattern is unknown.
10.3: Specific structure and functions	Conclusion on Structure and function reached because habitat condition data indicates that less than c.5% of the habitat is in unfavourable (not good) condition.
10.4: Future prospects	Conclusion on Future prospects reached because: (i) the Future prospects for Range are unknown; (ii) the Future prospects for Area covered by habitat are unknown; and (iii) the Future prospects for Structure and function are unknown.
10.5: Overall assessment of Conservation Status	Overall assessment of Conservation Status is Unknown because two or more of the conclusions are Unknown.
11.1: Surface area of the habitat type inside the pSCIs, SCIs and SACs network	98% of this habitat is inside a NSN Inshore a) Minimum = 0.036 km2 (4 confirmed areas of Holden's Reef b) Maximum= 0.087 km2(All areas identified (confirmed and un confirmed) from side scan)

	c) Best single value= 0.036 km2 Offshore a) Minimum = 57 km2(JNCC, 2024) b) Maximum=unknown c) Best single value= 57 km2(JNCC, 2024) Overall a) Minimum = 57.036 km2 b) Maximum= unknown c) Best single value= 57.036 km2
11.2: Type of estimate	Inshore: Best estimate Offshore:Minimum
5.13: Favourable Reference Area (FRA)	The UK-level FRV for surface area was developed by JNCC using an audit trail based on the year the FRV was first established and any changes made in subsequent reporting rounds. The audit may draw from any combination of the 2007, 2013, or 2019 Habitats Directive reports and reflects the full rationale used for the 2019 Article 17 reporting. This FRV was reviewed by Welsh experts and considered appropriate for use in Wales based on current habitat extent and trends.
4.10: Favourable Reference Range (FRR)	The UK-level FRV for range was developed by JNCC using an audit trail based on the year the FRV was first established and any changes made in subsequent reporting rounds. The audit may draw from any combination of the 2007, 2013, or 2019 Habitats Directive reports and reflects the full rationale used for the 2019

Article 17 reporting. This FRV was reviewed by Welsh experts and considered appropriate for use in Wales based on current distribution and trends.