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Condition Assessments for Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) and *Salicornia* and other annuals colonising mud and sand in Welsh Special Areas of Conservation

Report No: 892

Author Name: M. Jackson-Bué, E. Wynter, S. Cuthbertson, S. Jones, H. Lewis and M. Hatton-Ellis.

Author Affiliation: Natural Resources Wales

Morfa Friog, saltmarsh in the Mawddach Estuary © Heather Lewis (NRW)

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Approved By: Winterton, A.

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Contents

List of Figures

List of Tables

Crynodeb Gweithredol

Er mwyn rheoli ein hardaloedd morol gwarchodedig yn effeithiol ac yn gynaliadwy, mae'n hanfodol deall cyflwr eu cynefinoedd a'u rhywogaethau gwarchodedig. Mae gwybod cyflwr nodweddion dynodedig yn caniatáu i ni dargedu rheolaeth ac adnoddau lle mae eu hangen i wella ac adfer cyflwr.

Mae'r adroddiad tystiolaeth hwn, a gyflwynwyd fel rhan o brosiect gwella cyngor cadwraeth forol (IMCA) a ariannwyd gan Lywodraeth Cymru, yn cyflwyno canfyddiadau asesiadau cyflwr Cyfoeth Naturiol Cymru ar gyfer Dolydd ar forfeydd arfordir y gorllewin *Glauco-Puccinellietalia maritimae* a *Salicornia* a phlanhigion unflwydd eraill sy'n cytrefu llaid a thywod *Salicornia* o fewn ardaloedd cadwraeth arbennig dynodedig (ACA) ledled Cymru. Mae Adran 1 yn rhoi trosolwg o'r broses asesu ac mae Adran 2 yn darparu disgrifiad a lleoliad y nodwedd(ion).

Mae'r asesiadau'n seiliedig ar y dystiolaeth orau a oedd ar gael ar y pryd (e.e. 2024). Adroddir canlyniadau asesiadau gyda hyder cysylltiedig yn y casgliad. Gellir dod o hyd i esboniadau manwl o'r rhesymeg y tu ôl i gasgliadau, ac unrhyw resymau dros fethu, yn yr asesiad cyflwr llawn yn Adran 3. Gellir dod o hyd i adroddiad ar y broses asesu a ddefnyddiwyd yn adroddiad terfynol yr IMCA.

Crynodeb o asesiadau cyflwr ar gyfer Dolydd ar forfeydd arfordir y gorllewin mewn ACAau ledled Cymru

Lleoliad y nodwedd ACA	Asesiad cyflwr	Hyder yn yr asesiad
Glannau Môn: Cors heli	Ffafriol	Canolig
Pen Llŷn a'r Sarnau	Anffafriol	Isel
Sir Benfro Forol	Anffafriol	Isel
Bae Caerfyrddin ac Aberoedd	Anffafriol	Isel
Cynffig	Ffafriol	Isel

Crynodeb o asesiadau cyflwr ar gyfer *Salicornia* mewn ACAau ledled Cymru

Lleoliad y nodwedd ACA	Asesiad cyflwr	Hyder yn yr asesiad
Glannau Môn: Cors heli	Ffafriol	Isel
Pen Llŷn a'r Sarnau	Ffafriol	Isel
Bae Caerfyrddin ac Aberoedd	Ffafriol	Isel

Executive summary

To manage our marine protected areas effectively and sustainably it is vital to understand the condition of their protected habitats and species. Knowing the condition of designated features allows management and resources to be targeted where it is needed to improve and restore condition.

This evidence report, which was delivered as part of the Welsh Government funded improving marine conservation advice (IMCA) project, presents the findings of NRW's condition assessments for Atlantic salt meadows *Glauco-Puccinellietalia maritimae* and *Salicornia* and other annuals colonising mud and sand *Salicornia* within designated special areas of conservation (SACs) across Wales. Cross-border sites are not included in this report but will hopefully be considered in future. Section 1 gives an overview of the assessment process and section 2 provides a description of the features.

The assessments are based on the best evidence available at the time (e.g. 2024). Assessment outcomes are reported with an associated confidence in the conclusion. Detailed explanations of the rationale behind conclusions, and any reasons for failure, can be found in the full condition assessment in section 3. A report on the assessment process used can be found in the IMCA final report.

Summary of condition assessments for Atlantic salt meadows in SACs across Wales.

SAC feature occurs in	Condition assessment	Confidence in assessment
Anglesey Coast: Saltmarsh	Favourable	Medium
Lleyn Peninsula and the Sarnau	Unfavourable	Low
Pembrokeshire Marine	Unfavourable	Low
Carmarthen Bay and Estuaries	Unfavourable	Low
Kenfig	Favourable	Low

Summary of condition assessments for *Salicornia* in SACs across Wales.

SAC feature occurs in	Condition assessment	Confidence in assessment
Anglesey Coast: Saltmarsh	Favourable	Low
Lleyn Peninsula and the Sarnau	Favourable	Low
Carmarthen Bay and Estuaries	Favourable	Low

1. Introduction

It is important for NRW to understand the condition of designated features in marine protected areas (MPAs) to allow NRW to prioritise management actions and advise on activity in the marine environment.

Having robust, evidence-based assessments of feature condition will ultimately lead to better protection through better management. The improvements in condition brought about by implementing targeted management will ultimately improve the resilience of Wales' marine ecosystems. As MPAs in Wales cover extensive areas of sea and coast, it can be challenging and resource intensive to monitor them. This can make thorough assessments of feature condition difficult. The process used for these condition assessments builds on work undertaken to produce indicative condition assessments published in 2018.

The 2018 indicative assessments used all available data and expert judgement to assess features using a workshop approach with internal NRW specialists. The new full assessment process, which has been delivered through the Welsh Government funded improving marine conservation advice (IMCA) project, has been improved by using carefully chosen performance indicators judged to be the most appropriate to assess condition (see section 3). The best available evidence has been used to conduct the assessments. Due to the differences in assessment methods between these full assessments and the indicative condition assessments, the results are not directly comparable. Cross-border sites are not included in the assessment report due to resource limitations, but NRW hopes to take forward cross-border sites condition assessments in the future.

1.1. Assessment process

Marine feature condition assessments in NRW consist of selecting performance indicators for the feature, gathering the best available evidence to assess those indicators and conducting the assessment.

Performance indicators have targets which have a primary, secondary or tertiary weighting. Failure of a primary target will mean the feature is classified as unfavourable, on a 'one out all out' basis. If all primary targets pass but two secondary targets fail, the feature would also be classified as unfavourable. Likewise, if all primary and secondary targets pass but three tertiary targets fail, the feature will also be unfavourable. Condition assessment outcomes are not strictly determined by target weightings and are also subject to expert judgement.

Each indicator result has an associated confidence which is determined by the quality and age of the evidence along with the confidence in the indicator itself and what it is telling us about condition of the feature. The confidence in the overall assessment is derived from the confidence in each target pass or failure, as well as expert judgment/ assessor consensus.

Each feature condition assessment will also identify reasons for indicator failure where known and any known threats to feature condition.

Table 1 summarises the steps taken in marine feature condition assessments. Details on the full condition assessment process, including indicator selection and target weighting can be found in the IMCA final report.

Table 1. The main steps of the marine feature condition assessment process.

Assessment Step	Process
Step 1: Preparation and evidence gathering.	Prepare site information. Source relevant evidence and any previous assessments. Evaluate quality of evidence according to suitability for use in assessments and carry out any analysis required.
Step 2: Indicator assessment.	A range of NRW specialists use all available evidence to assess the performance indicators and targets using a pass, fail or unknown. Record findings in the condition assessment form. Provide a confidence score for each target conclusion.
Step 3: Feature level assessments.	Combining the results from the assessment of feature indicators to provide an overall assessment of condition at the feature level.
Step 3.5. Complex features.	If the feature is a complex feature (i.e., estuaries or large shallow inlets and bays) consider the results of any nested feature assessments within the overall complex feature assessment.
Step 4: Condition pressures and threats.	Use the evidence gathered and information on management and activities to determine threats and pressures on feature condition.
Step 5: Finalise the assessments.	Ensure all required fields in the assessment have been completed and all assessed targets have an associated confidence. Circulate the reports to the relevant NRW specialists for review and comment. After issues have been resolved, the assessments will be signed off by the project task and finish group.
Step 6: Publish the assessments.	After signing off, the assessments will be published on the NRW website, and stakeholders and internal staff notified. Assessments are then ready to use by internal and external parties.

2. Feature descriptions

2.1. Description for Atlantic salt meadows (*Glauco-Puccinellietalia maritima*)

The following text is the habitat description from the JNCC list of Annex I marine, coastal and halophytic habitats.

"Atlantic salt meadows develop when halophytic vegetation colonises soft intertidal sediments of mud and sand in areas protected from strong wave action. This vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation still occurs but with decreasing frequency and duration. A wide range of community types is represented and the saltmarshes can cover large areas, especially where there has been little or no enclosure on the landward side. The vegetation varies with climate and the frequency and duration of tidal inundation. Grazing by domestic livestock is particularly significant in determining the structure and species composition of the habitat type and in determining its relative value for plants, for invertebrates and for wintering or breeding waterfowl."

Within Wales saltmarsh transitions with terrestrial habitats which are inundated by the highest tides are mapped together with saltmarsh habitat and have been included with the Atlantic salt meadows feature, these include brackish reedbeds, swamp communities and inundation grasslands. The range of plant communities which makes up the Atlantic salt meadows habitat type is currently under review.

2.2. Description for *Salicornia* and Other Annuals Colonising Mud and Sand

The following text is the habitat description from the JNCC list of Annex I marine, coastal and halophytic habitats.

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

3. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

This section contains assessments for the Atlantic salt meadows (ASM) in marine ardal cadwraeth arbennig (ACA) / special areas of conservation (SAC). The feature is designated in five SACs in Wales (Figure 1):

- Glannau Môn: Cors heli / Anglesey Coast: Saltmarsh
- Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau
- Sir Benfro Forol / Pembrokeshire Marine
- Bae Caerfyrddin ac Aberoedd / Carmarthen Bay and Estuaries
- Cynffig / Kenfig

More information on the SACs and their features can be found in NRW's conservation advice on our website.

For most of the sites, multiple saltmarshes were assessed. Saltmarshes have been assessed against the chosen performance indicators. Any gaps in evidence that would improve the assessment of condition have been identified for each SAC (Section 5).

The performance indicators were assessed using a combination of NRW Habitats Regulations monitoring, Water Environment (Water Framework Directive) Regulations 2017 (WFD Regulations) monitoring, commissioned evidence reports, scientific literature, external monitoring databases (e.g. National Biodiversity Network (NBN) Atlas), plan and project assessments and expert judgement. The outcome of the assessment and reasons for failure are discussed in more detail in the sections below.

In these condition assessments, the WFD 2024 cycle 3 interim classification was the default information used for water quality, however other earlier cycles were referenced, as follows:

- 2009 cycle 1 classification
- 2015 cycle 2 classification
- 2018 cycle 2 interim classification
- 2021 cycle 3 classification

In the WFD classification, results are rolled forward from previous assessments where there are no new monitoring data to provide a new classification. It is used to gap fill and provide a more complete classification. A decision was made to limit roll forward to six years which has been applied to the 2024 cycle 3 interim classification.

Additional information on water quality can be found in the IMCA final report.

The feature maps in this document are for illustrative purposes only. Detailed maps for the features in Wales can be found on Data Map Wales.

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Figure 1. Location of SACs assessed for the ASM feature.
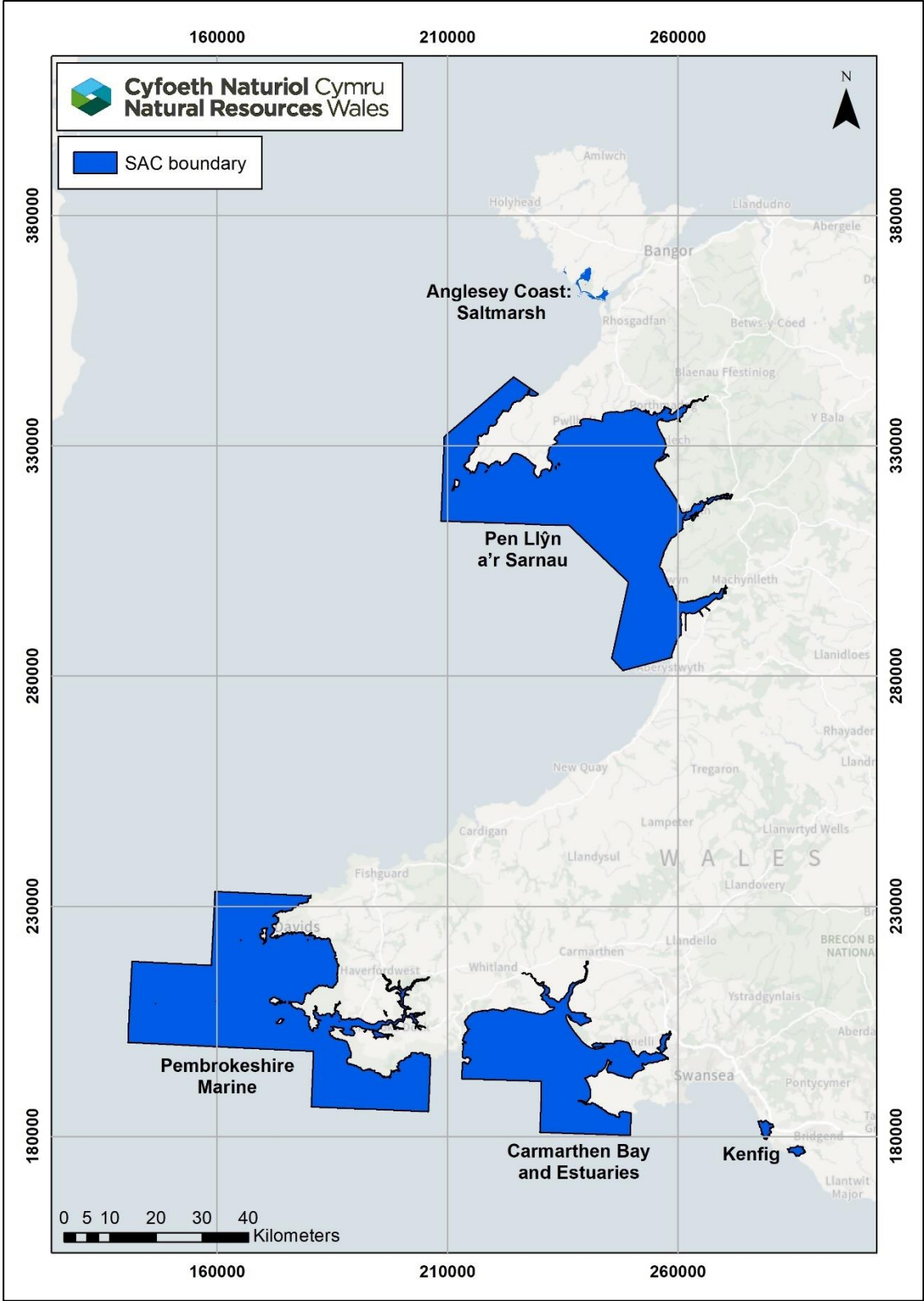
3.1 Anglesey Coast: Saltmarsh SAC condition assessment

The Atlantic salt meadows (ASM) feature, also known as saltmarsh, in Anglesey Coast: Saltmarsh SAC includes saltmarshes from the Ffraw, Braint and Cefni estuaries (Figure 2). The ASM feature has been assessed against the performance indicators and an overall condition was assigned for the feature.

Figure 2. Map of the ASM feature in Anglesey Coast: Saltmarsh SAC.
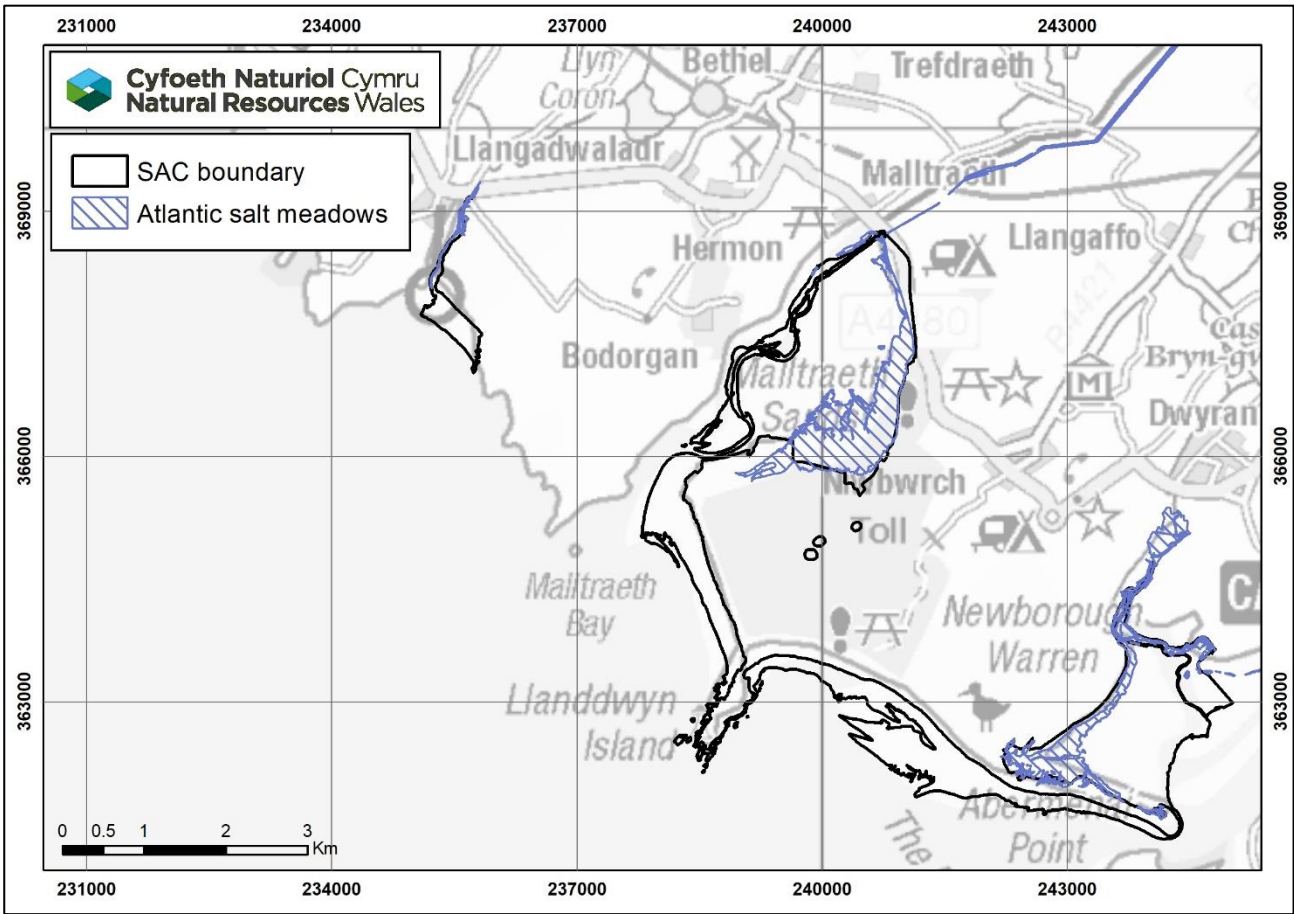
Table 2 has a summary of the assessment outcome against each performance indicator. The outcomes and any reasons for failure are discussed in more detail in the sections below.

Table 2. Condition assessment of the ASM feature in Anglesey Coast: Saltmarsh SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature extent	The extent of the saltmarsh within the SAC should be stable or increasing, allowing for natural change and variation. (P)	• Between 2000 and 2018-2021, there has been a gain of 24.87 ha (16%) of saltmarsh extent. • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.	**Pass**	Medium
Distribution of feature	Maintain the distribution of saltmarsh throughout the SAC, allowing for natural change and variation. No significant loss from any of the defined sectors. Significant is defined as loss from any sector not to exceed 20%. (P)	• There has been no significant loss of saltmarsh extent in any of the defined sectors. • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.	**Pass**	Medium
Distribution and extent of habitats and communities	Maintain the distribution and extent of saltmarsh habitats and communities, allowing for natural change. (P)	• The available NVC maps date from 1998 and are too old to use for an assessment of distribution and extent.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Physical structure: creeks and pans	Maintain the expected patterns of creeks and pans throughout the SAC, allowing for natural change and variation (P). Artificial drainage channels adversely affecting hydrology are absent or rare. (P)	• There are no anthropogenic impacts known to have significantly affected the creeks and pans in the saltmarsh since SAC designation. • There are currently no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. • As the saltmarsh in the SAC is relatively small, any significant impact would likely be noticed, therefore the confidence in the pass is high.	**Pass**	High
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (T)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the saltmarsh. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the saltmarsh. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the environmental quality standards (EQS). (T)	• Three of the four overlapping WFD waterbodies were not classified as the chemicals have not been assessed within the last six years (Cefni, Braint and Ffraw). Combined, these waterbodies overlap with 23% of the feature. • The other WFD waterbody has a pass for chemicals, however all chemical classifications were rolled forward from the 2018 cycle 2 interim classification (Menai Strait). This waterbody overlaps with 16% of the ASM feature. • Confidence is to low due to the unclassified waterbodies and the rolled forward classifications; and as the WFD water quality sampling is not focused on saltmarshes.	**Pass**	Low
Water quality: nutrients (Dissolved Inorganic Nitrogen - DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• One of the four overlapping WFD waterbodies was classified with a High status for the DIN WFD element in the 2024 cycle 3 interim classification (Menai Strait). This waterbody overlaps with 16% of the feature. • One WFD waterbody was classified with a Good status for DIN (Cefni). However, the confidence of the classification was uncertain and it is not certain if there has been a true improvement in DIN since the 2021 cycle 3 classification of Moderate status. This waterbody overlaps with 20% of the feature. • The other two WFD waterbodies were classified with a Poor and Bad status (Braint and Ffraw). Combined, these overlap with 3% of the feature. • Confidence is low as there is uncertainty in the Cefni waterbody classification, and as the WFD water quality sampling is not focused on saltmarshes.	**Fail**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• Two of the four overlapping WFD waterbodies were classified with High status for the opportunistic macroalgae WFD element in the 2024 cycle 3 interim classification (Cefni and Ffraw). These waterbodies overlap with 20% and <1% of the feature respectively. • One WFD waterbody was not classified for the opportunistic macroalgae WFD element (Menai Strait). This waterbody overlaps with 16% of the feature. • The other WFD waterbody was classified with a Moderate status (Braint). It overlaps with 3% of the feature. • Confidence is low as the WFD water quality sampling is not focused on saltmarshes, and because the failing waterbody overlaps with a small proportion of the feature.	**Fail**	Low
Air quality	Nitrogen deposition should not exceed the critical load range of 10-20 kg N per ha^{-1} per year. (S)	• Nitrogen deposition within the SAC (where data were available) was under 12 kg N per ha per year for all saltmarshes and did not exceed the upper range of the critical load on average (UK Air Pollution Information System (APIS)). • Confidence is medium as the pass is based on the upper range of the critical load of nitrogen deposition.	**Pass**	Medium
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, structure and diversity of ASM plant communities within the sectors of the SAC, allowing for natural change and variation. (P)	• The limited WFD data available was analysed for the Cefni waterbody. This analysis indicated that the overall species richness of the ASM plant communities was good. • Species richness gives some indication of the condition of the ASM plant communities, but more analysis is required, resulting in a low confidence.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Vegetation structure: sward height	Maintain the expected structural variation within the sward height, allowing for natural change and variation. The majority of plants should be able to produce flowers and set seed. (P)	• There is no evidence of major grazing impact on the feature therefore the target was met. • Confidence is high as this feature is in a National Nature Reserve and therefore it is well-maintained.	**Pass**	High
Vegetation structure: zonation of vegetation	Maintain the expected range of saltmarsh zonation for the SAC, allowing for natural change and variation. (P)	• The WFD data analysis indicated that all zones were increasing with limited concern. • Confidence is medium as the changes in zonation were estimated by comparing 2011 and 2019 extents for one of the three relevant WFD waterbodies.	**Pass**	Medium
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence of INNS presence within the ASM feature. • Confidence is medium as the spread and impacts of any INNS present within the SAC are not well understood, and there have been no targeted surveys of NNS within the ASM feature.	**Pass**	Medium
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There are no known records of NNS within the ASM feature. • Confidence is low as there are no targeted surveys for NNS within the feature, and as there is a concern about non-native conifers spreading onto the transition of other semi-natural coastal habitats.	**Pass**	Low

Assessment conclusions

The Atlantic salt meadow (ASM) feature in the Anglesey Coast: Saltmarsh SAC has been assessed as being in **favourable** condition (medium confidence). Overall, the lack of any significant anthropogenic impact on this feature in terms of extent, topography and physical processes, and its associated communities, have contributed to this favourable assessment outcome, and the saltmarsh at this SAC appears to have expanded. There were two indicators with failing targets (Table 3). There were also limited or absent data for two key indicators to inform on the condition of the feature (see evidence gaps section 5). This has reduced the confidence in the assessment conclusion. Further investigation is needed to better understand the indicator failures to be able to identify management options.

A summary of the assessment can be seen in Table 3 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 3. Summary of the condition assessment for the ASM feature in Anglesey Coast: Saltmarsh SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Anglesey Coast: Saltmarsh	**Favourable (medium confidence)**	Water quality: opportunistic macroalgae (S) Water quality: nutrients (DIN only) (T)	• There has been opportunistic macroalgae growth in the Braint waterbody. • Nutrient levels are high in the Cefni, Braint and Ffraw waterbodies.	• Unconsented infrastructure • INNS • Shading by the forest • Critical load for nitrogen deposition • Water quality: contaminants • Climate change

Detailed assessment information

Extent and distribution

Saltmarsh extent has been mapped using aerial imagery from 2000 and 2018-2021. The total extent of saltmarsh was measured as 180.5 ha in 2018-2021 compared to 155.63 ha in 2000, indicating a total gain of 24.87 ha (16%). There has been no loss of saltmarsh extent in any of the sectors, with instead a gain in extent in each of the three defined sectors. As a result, both the feature extent and distribution of the feature indicators met their targets. The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.

The distribution and extent of habitats and communities, a key indicator to inform on the condition of the feature, was assessed as unknown as the available NVC maps date from 1996 and 1998 (Prosser and Wallace, 1997; 1999a). These were deemed too old to be representative of the current situation. The lack of more up to date maps meant change could not be assessed.

Physical structure

There are no anthropogenic activities known to have significantly affected the creeks and pans in the saltmarsh since designation and no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. The physical structure (creeks and pans) indicator therefore passed its target. As the saltmarsh within the SAC is relatively small, any significant impact to the saltmarsh would likely be noticed. For these reasons, the confidence in the indicator pass is high. The saltmarsh extent in this SAC is smaller compared to other SACs therefore it is possible to be more confident that there have been minimal impacts. The assessment of this indicator was based on expert judgment.

Hydrodynamic processes and topography

The hydrodynamic and sediment transport processes, and the topography of the feature indicators were assessed as passing their targets as there are currently no known anthropogenic activities that would have significantly altered these aspects. These assessments were based on expert judgement and knowledge of assessments of plans and projects within the SAC. The SAC is relatively small which allows for changes to been seen more easily than a larger SAC. However, hydrodynamic processes are not well understood and could involve effects from further away. It is also difficult to be certain of impacts on the condition of the feature in the absence of data. This has reduced the confidence in the assessment to medium. In future, Lidar data could potentially be used to quantify changes in topography.

Water and air quality

It has been estimated that approximately 39% of the ASM feature within the SAC falls within four WFD waterbodies. The upper marsh areas are above the high-water mark and are therefore outside of the WFD waterbody boundary. However, marine water input to the upper marsh will be from these waterbodies therefore these waterbodies are likely to be a

good reflection of the overall effect of water quality on the feature. However, as the WFD water quality sampling is not focused on saltmarshes, the confidence has been reduced in all of the relevant water quality assessments.

Contaminants

The contaminants indicator met the target as one WFD waterbody has a pass for chemicals in the 2024 cycle 3 interim classification. This waterbody, Menai Strait, overlaps with 16% of the ASM feature. The chemical classifications for this waterbody were rolled forward from the 2018 cycle 2 interim classification. This reduced the confidence in the pass. The confidence was further reduced to low as the other three WFD waterbodies were not classified as the chemicals have not been assessed within the last six years. Combined, these waterbodies overlap with 23% of the feature. The impact of any contaminants on the feature are not fully understood. The target weighting of the indicator is tertiary to reflect this.

Nutrients (DIN only) and opportunistic macroalgae

The Cefni waterbody was classified with a Good status for the dissolved inorganic nitrogen (DIN) element in the 2024 cycle 3 interim classification. This is an improvement from Moderate status in all cycles since the 2015 cycle 2 classification. However, the confidence in the 2024 Good status classification is uncertain (confidence of Good or better classification: 55%, confidence of Moderate or worse classification: 45%). The 2021 cycle 3 and 2024 cycle 3 interim DIN classifications used different methodologies due to changes in the classification process. There has been an improvement in the DIN values recorded between the classifications, however the confidence of the improvement in class for this waterbody is uncertain. The 2021 WFD investigation report (Jones, 2021a) for this waterbody confirmed the DIN failure in the 2021 cycle 3 classification, but found that there has not been a biological response to the elevated nutrients. This waterbody overlaps with the largest proportion of the feature (20%).

Two WFD waterbodies, Braint and Ffraw, were classified with Poor and Bad statuses for DIN in the 2024 cycle 3 interim classification. The Ffraw waterbody classification has deteriorated from Poor status in the 2021 cycle 3 classification to Bad status in the 2024 cycle 3 interim classification. However, the confidence of the deterioration is uncertain (52%). While the overlap of these waterbodies is small (3%), they do not include the areas of the feature which are at the limit of the waterbodies. These areas may have elevated DIN as well but it has not been sampled. The Menai Strait waterbody was classified with a High status for DIN, however the sampling locations were not in close proximity to the ASM feature in the SAC.

The nutrients indicator (DIN only) failed to meet the target due to the issues with DIN in the Cefni, Braint and Ffraw waterbodies. The confidence was reduced to low as the Cefni waterbody was classified as Good status in the 2024 cycle 3 interim classification but with uncertainty in this classification. In addition, because the WFD water quality sampling is not focused on saltmarshes. The nutrients indicator (DIN only) was also given a tertiary weighting as the effects of high nutrient levels on the ASM feature are not fully understood.

The opportunistic macroalgae indicator was assessed as failing due to the Moderate status classification for this biological element in the Braint waterbody in the 2024 cycle 3 interim classification. There are excessive levels of algae in the intertidal area which suggests that nutrient enrichment is causing elevated growth in these species. This waterbody overlaps

with a small proportion of the feature (3%). Two WFD waterbodies were classified with a High status for the opportunistic macroalgae element in the 2024 cycle 3 interim classification. These waterbodies, Cefni and Ffraw, overlap with 20% and <1% of the feature. One WFD waterbody, Menai Strait, was not classified for the element. Some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum (i.e. areas of intertidal habitat for opportunistic macroalgal growth). The confidence in the failure of this indicator was reduced to low as the WFD water quality sampling is not focused on saltmarshes, and because the failing waterbody overlaps with a small proportion of the mapped feature.

Air quality

High levels of nitrogen (N) deposition from the atmosphere can have detrimental impact on saltmarshes since they are nitrogen limited. The nitrogen deposition within the SAC, where data were available, was under 12 kg N per ha per year for all saltmarshes and therefore did not exceed the upper range of the critical load (20 kg N per ha per year, UK Air Pollution Information System (APIS)). If the assessment was based on the lower range of the critical load (10 kg N per ha per year), the indicator would fail to meet its target. For this reason, confidence was reduced to medium.

Species and communities

The analysis of transect data from WFD Regulations monitoring showed that overall, ASM plant species richness was good for the Cefni waterbody. While there is no WFD sampling for the two other saltmarshes within the Ffraw and the Braint waterbodies, data from the Cefni waterbody alone was deemed sufficient to pass the abundance, distribution and species composition of communities indicator. As more analysis is required to effectively assess the condition of saltmarsh communities across the feature, the confidence in the pass has been reduced to low.

Vegetation structure

Both the sward height and zonation of vegetation indicators met their targets. No major grazing issues were identified. The confidence for the sward height indicator is high as this feature is in a National Nature Reserve and therefore it is well-maintained. The WFD data analysis showed a small change in zonation pattern, but this is likely to be natural and is of limited concern. The confidence in the zonation of vegetation indicator was reduced to medium as the changes in zonation were estimated by comparing 2011 and 2019 extents for one out of three WFD waterbodies. Further data and ground truthing investigations would be needed to increase confidence.

Invasive non-native species

The saline conditions of saltmarshes prevent the common terrestrial non-native species (NNS) in Wales becoming established. There are no known records of NNS within the ASM feature, resulting in both the primary and tertiary targets for the invasive non-native species (INNS) and NNS indicators to be met.

The primary INNS target passed with a medium confidence as there have been no targeted NNS surveys on saltmarshes, which would be required to fully understand the presence and impacts of any NNS species within the ASM feature.

The red seaweed worm wart *Gracilaria vermiculophylla,* a species native to Vietnam and the West Pacific coast, was recorded for the first time in 2022 in nearby mudflats and sandflats habitat in the Malltraeth estuary. However, there is no known record of the species in the saltmarsh habitat. There are some concerns about the non-native coniferous trees in the Cefni saltmarshes encroaching the transition of other semi-natural coastal habitats. Therefore, confidence in the pass for the tertiary NNS target was reduced to low to reflect this, and for the same reason as the primary INNS target.

Reasons for target failure

The ASM feature in Anglesey Coast: Saltmarsh SAC has been assessed as being in **favourable** condition. However, one secondary target and one tertiary target failed to be met and need to be kept under review.

Water quality: opportunistic macroalgae

This indicator target has a secondary weighting. The Braint waterbody was classified with a Moderate status for the opportunistic macroalgae biological element in the 2024 cycle 3 interim classification. There are excessive levels of algae in the intertidal area which suggests that nutrient enrichment is causing elevated growth in these species. The WFD investigation in this waterbody is ongoing.

Water quality: nutrients (DIN only)

This indicator target has a tertiary weighting. Two of the WFD waterbodies that overlap with the feature, the Braint and Ffraw waterbodies, were classified with a failing status for the DIN element in the 2024 cycle 3 interim classification. The WFD investigations of the failures in these waterbodies are ongoing, but both have confirmed the failures in the DIN classifications at stage 1 (Borrowdale and Moore, in draft; Burton, in draft). Stage 2 of the investigations to identify potential reasons for failure have not yet been completed.

A third WFD waterbody, Cefni, whilst classified as Good in the 2024 cycle 3 interim classification, remained close to the failure threshold. This waterbody was Moderate status in the 2021 cycle 3 classification. Different methodologies were used for the assessment of the DIN in the 2021 and 2024 classification, therefore there is uncertainty that there has been a genuine improvement in class. The 2021 WFD investigation report for the Cefni waterbody confirmed the DIN failure, but found that there has not been a biological response to the elevated nutrients in the WFD waterbody (Jones, 2021a). It was concluded that the major input of nutrients is likely to be derived from diffuse sources associated with agriculture and rural land management, and point sources from the water industry (Jones, 2021a).

Threats to condition

Part of the condition assessment is to identify threats to the condition of the ASM feature. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition. The threats to the condition of the ASM feature in Anglesey Coast: Saltmarsh SAC are stated below.

Unconsented infrastructure

New unconsented infrastructure such as private slipways and coastal defences, modify the coastal environment through changes to micro-topography and hydrodynamics and can lead to loss of the feature extent, and impacts to the flora and fauna associated with it.

Invasive non-native species

G. vermiculophylla has the capacity to turn saltmarsh pools anoxic, destroying the pool fauna and flora (Maggs and Magill, 2014). At high densities, this red seaweed could turn the sediments anoxic, reducing their capacity to support saltmarsh plants and animals and change the sedimentation regime (increase sedimentation of muds), and could alter the habitat in the long-term if it is in high density (Maggs and Magill, 2014).

The non-native conifers and broadleaves trees in Cefni can encroach the sand dune and saltmarsh, and could have a detrimental effect on the natural transition of the saltmarsh.

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Shading by the forest

Shading by taller vegetation is likely to impact the saltmarsh vegetation by changing vegetation communities. This is a concern for some areas in Cefni where the natural transition of saltmarsh has been replaced by hard coniferous species with a greater potential to shade the saltmarsh communities.

Critical load for nitrogen deposition

The saltmarsh habitat is sensitive to nitrogen deposition from the atmosphere, so it is important that the current level of nitrogen deposition does not exceed the critical load of 10-20 kg N per ha per year. Although current critical load levels of nitrogen deposition were not exceeded for the ASM feature in the Anglesey Coast: Saltmarsh SAC, the air quality indicator would fail if it was assessed against the lower range of the critical load (e.g. 10 kg N per ha per year).

Water quality: contaminants

There is the potential for unregulated contaminants (such as Per- and polyfluoroalkyl substances (PFAS)) to increase. This could affect some of the biota of the ASM feature as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024; Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent.
- Changes in air temperature.
- Increases in wave exposure.
- Changes in species distribution.

3.2 Pen Llŷn a`r Sarnau SAC condition assessment

The Atlantic salt meadows (ASM) feature, also known as saltmarsh, in Pen Llŷn a`r Sarnau SAC includes saltmarshes from the Glaslyn, Dwyryd, Mawddach, Artro and Dyfi estuaries (Figure 3). The ASM feature has been assessed against the performance indicators and an overall condition was assigned for the feature.

Figure 3. Map of the ASM feature in Pen Llŷn a`r Sarnau SAC.
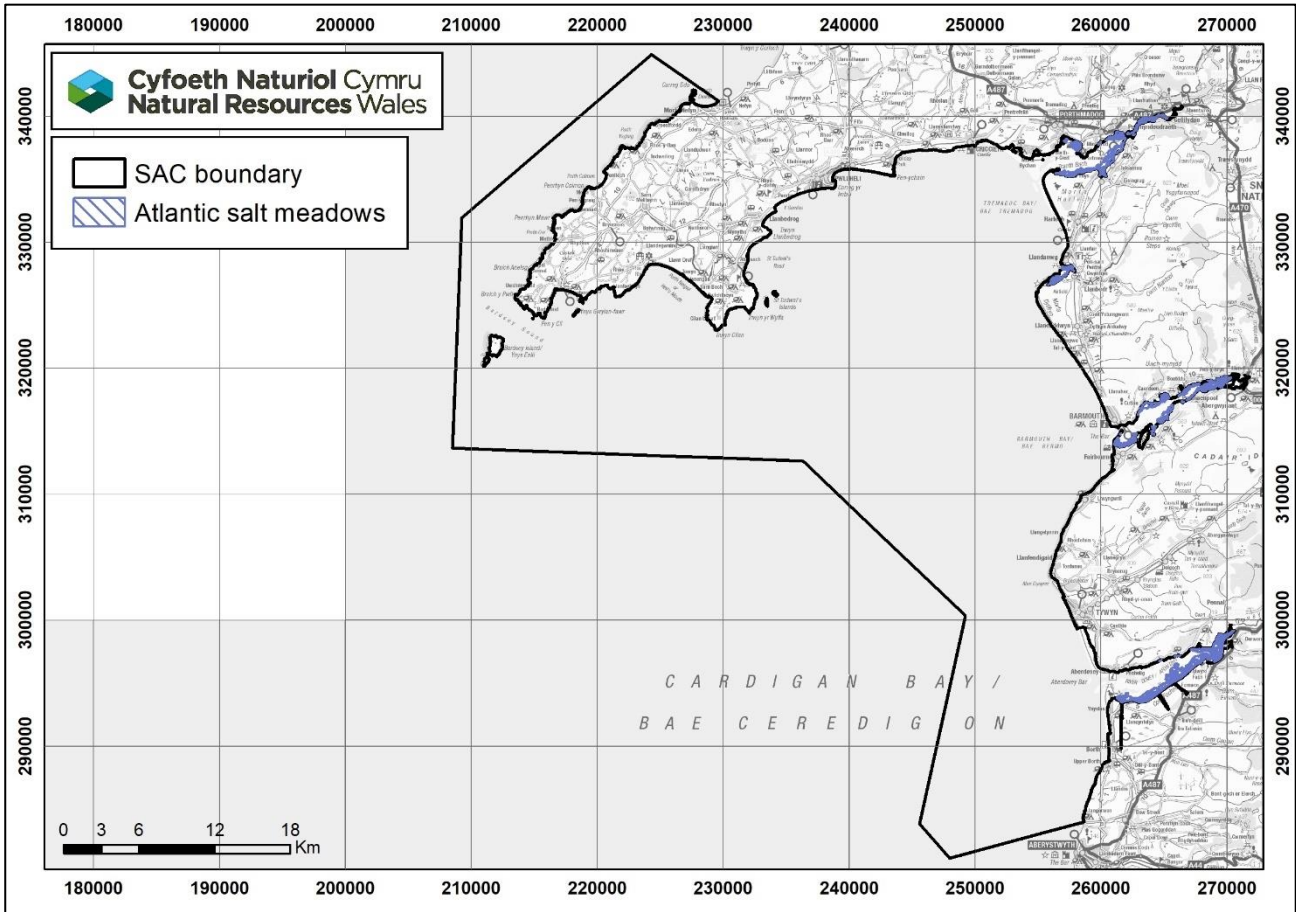
Table 4 has a summary of the assessment outcome against each performance indicator. The outcomes and any reasons for failure are discussed in more detail in the sections below.

Table 4. Condition assessment of the ASM feature in Pen Llŷn a`r Sarnau SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature extent	The extent of the saltmarsh within the SAC should be stable or increasing, allowing for natural change and variation. (P)	• Between 2000 and 2020-2021, there has been a gain of 12.4 ha (1%) of saltmarsh extent. • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.	**Pass**	Medium
Distribution of feature	Maintain the distribution of saltmarsh throughout the SAC, allowing for natural change and variation. No significant loss from any of the defined sectors. Significant is defined as loss from any sector not to exceed 20%. (P)	• There has been no significant loss of saltmarsh extent in any of the defined sectors. • There has been a loss of approximately 5% in the Morfa Harlech sector was highlighted but requires ground truthing to confirm. • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.	**Pass**	Medium
Distribution and extent of habitats and communities	Maintain the distribution and extent of saltmarsh habitats and communities, allowing for natural change. (P)	• The available NVC maps date from 2003 and are too old to use for an assessment of distribution and extent.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Physical structure: creeks and pans	Maintain the expected patterns of creeks and pans throughout the SAC, allowing for natural change and variation (P). Artificial drainage channels adversely affecting hydrology are absent or rare. (P)	• There are no anthropogenic impacts known to have significantly affected the creeks and pans in the saltmarsh since SAC designation. • There are currently no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (T)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the saltmarsh. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the saltmarsh. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the EQS. (T)	• Two of the four WFD waterbodies that overlap with the feature were not classified as the chemicals have not been assessed within the last six years (Glaslyn and Artro). Combined, these overlap with 4% of the ASM feature. • One WFD waterbody has a pass for chemicals in the 2024 cycle 3 interim classification (Dyfi / Leri). However, all chemical classifications were rolled forward from the 2021 cycle 3 classification. This waterbody overlaps with 4% of the feature. • The other WFD waterbody has a fail for chemicals (Mawddach), due to PBDE. It overlaps with 13% of the feature. • Confidence is medium as the human health standard has been used for PBDE; some waterbodies have not been classified; and WFD water quality sampling is not focused on saltmarshes.	**Fail**	Medium
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• All four WFD waterbodies were classified as Good or High status for DIN in the 2024 cycle 3 interim classification (Mawddach, Dyfi / Leri, Glaslyn and Artro). Combined, these overlap with 21% of the feature. 　　○ Three of these waterbody classifications were rolled forward from previous cycles. • Confidence is medium due to the rolled forward classifications, and as WFD water quality sampling is not focused on saltmarshes.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the four WFD waterbodies was not classified for opportunistic macroalgae in the 2024 cycle 3 interim classification (Glaslyn). This waterbody overlaps with 3% of the feature. • The other three WFD waterbodies were classified with Good status for opportunistic macroalgae in the 2024 cycle 3 interim classification (Mawddach, Dyfi / Leri and Artro). Combined, these overlap with 17% of the feature. ○ The Mawddach waterbody classification was rolled forward from the 2021 cycle 3 classification. • Confidence is medium due to the unclassified waterbody and rolled forward classification; and as WFD water quality sampling is not focused on saltmarshes.	**Pass**	Medium
Air quality	Nitrogen deposition should not exceed the critical load range of 10-20 kg N per ha^{-1} per year. (S)	• Nitrogen deposition within the SAC (where data were available) was under 10 kg N per ha per year for all saltmarshes and did not exceed the critical load on average (APIS). • Confidence is high as the recorded nitrogen deposition is below the lower range of the critical load.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, structure and diversity of ASM plant communities within the sectors of the SAC, allowing for natural change and variation. (P)	• The analysis of WFD transect data showed that overall, plant species richness was good for the Artro waterbody and slightly poorer for the Dyfi / Leri waterbody. • Species richness is only one element to assess the condition of ASM plant communities across the feature. • No WFD sampling stations are available for the saltmarshes in the Mawddach, Glaslyn and Dwyryd estuaries. These sectors represent a large proportion of the ASM feature in the Pen Llŷn a`r Sarnau SAC, therefore this indicator was assessed as unknown. • Heavy grazing in some areas within the ASM feature are likely to impact the species composition, however no information is available to confirm this.	**Unknown**	N/A
Vegetation structure: sward height	Maintain the expected structural variation within the sward height, allowing for natural change and variation. The majority of plants should be able to produce flowers and set seed. (P)	• Heavy grazing was noted in the past in a few locations on the Dwyryd estuary, as well as a section of saltmarsh in the Mawddach and Dyfi estuaries. • The 2011 condition assessment indicated a failure for grazing. • Recent stakeholder interviews (2022) further identified heavy grazing in the Dyfi and the Dywyrd estuaries. • Recent visual observation made in October 2024 showed that heavy grazing is still occurring in the Dwyryd estuary (seaward locations). • Confidence is medium because the assessment was based on expert judgment and visual inspection rather than a targeted survey.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Vegetation structure: zonation of vegetation	Maintain the expected range of saltmarsh zonation for the SAC, allowing for natural change and variation. (P)	- WFD data analysis indicated changes in zonation, but it was judged to be from natural variation. - Confidence is medium as the pioneer zone is difficult to assess using aerial photography.	**Pass**	Medium
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	- There is limited evidence of INNS presence within the ASM feature. - Confidence is medium as the spread and impacts of any INNS present within the SAC are not well understood, and there have been no targeted surveys of NNS within the ASM feature.	**Pass**	Medium
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	- There have been no new NNS recorded within the ASM feature in the SAC. - Confidence is medium as there have been no recent targeted NNS surveys within saltmarsh.	**Pass**	Medium

Assessment conclusions

The Atlantic salt meadow (ASM) feature in Pen Llŷn a`r Sarnau SAC has been assessed as being in **unfavourable** condition (low confidence). There were a couple of indicators with failing targets (Table 5). There were also limited or absent data for three key indicators to inform on the condition of the feature (see evidence gaps section 5). This has reduced the confidence in the assessment conclusion. Further investigation is needed to better understand all of the failures to be able to identify management options that can bring the feature back into favourable condition. As the primary failure was localised, it has been mapped to help focus management effort (Figure 5).

A summary of the assessment can be seen in Table 5 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 5. Summary of the condition assessment for the ASM feature in Pen Llŷn a`r Sarnau SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Pen Llŷn a`r Sarnau	**Unfavourable (low confidence)**	Vegetation structure: sward height (P) Water quality: contaminants (T)	• There is heavy grazing by sheep in some sections of the Dwyryd and Mawddach saltmarshes. • Levels of PBDE in the Mawddach waterbody are failing to meet its relevant environmental quality standards (EQS).	• Unconsented infrastructure • INNS • Water quality: contaminants • Climate change

Figure 4. Map of the localised failure in the LSIB feature in Pen Llŷn a`r Sarnau SAC.
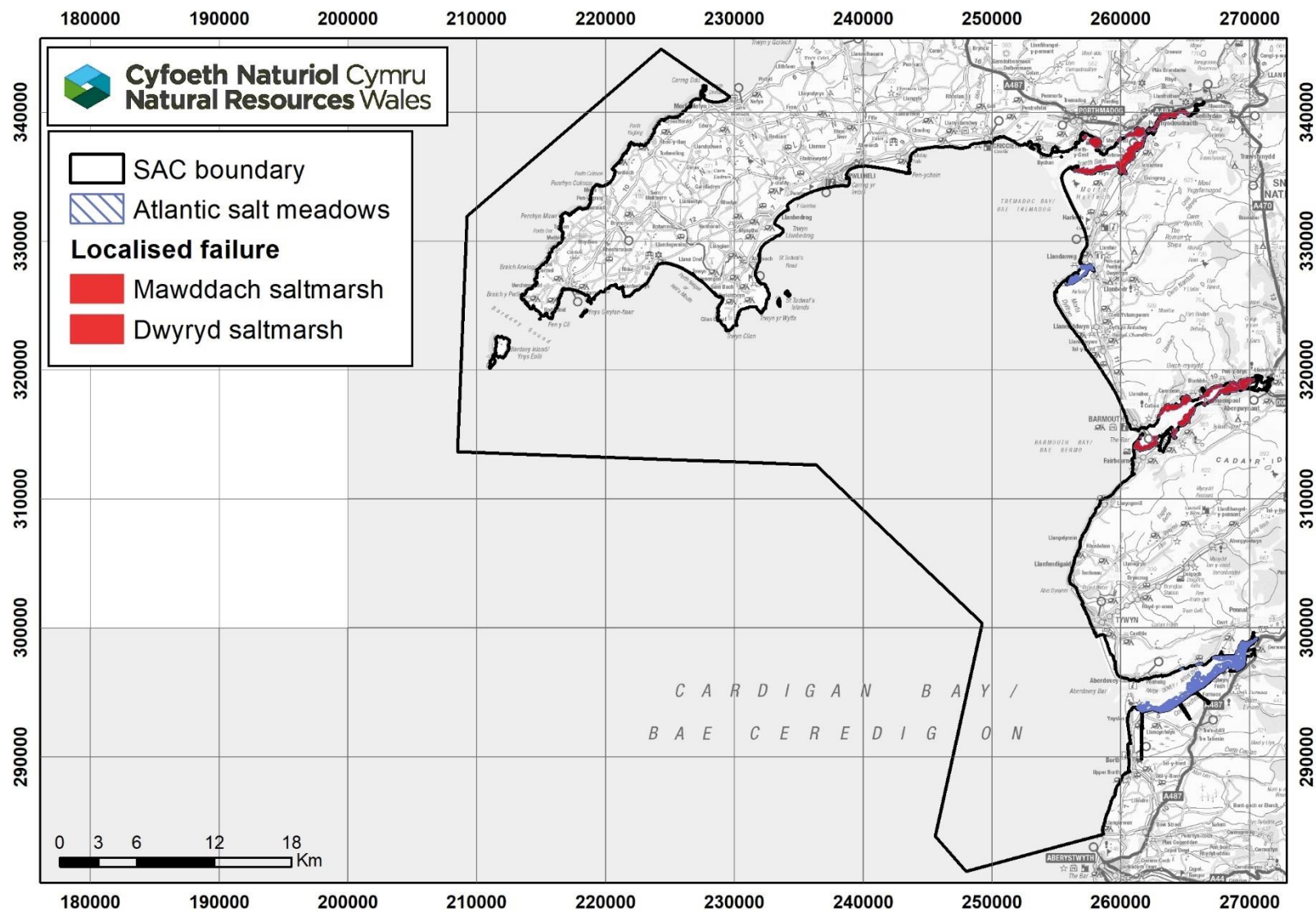
Detailed assessment information

Extent and distribution

Saltmarsh extent has been mapped using imagery from 2000 and 2020/2021. The total extent of saltmarsh was measured as 1230.58 ha in 2020/2021 compared to 1217.14 ha in 2000, indicating a total gain of 12.4 ha (1%). There has been no significant loss of more than 20% of saltmarsh extent in any of the defined sectors. The extent of saltmarshes has increased in two of the six defined sectors, and has not changed in one. There has been a minor loss in extent in three sectors. The sector with the largest loss was Morfa Harlech which has lost approximately 5% of the extent. However, ground truthing is required to confirm this loss. Both the feature extent and distribution of the feature indicators met their targets. The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. In addition, the extent includes saltmarsh areas as well as *Salicornia*. Therefore the confidence associated with the pass is medium.

The distribution and extent of habitats and communities, a key indicator to inform on the condition of the feature, was assessed as unknown as the available NVC maps (Prosser and Wallace, 2004) date from 2003. These were deemed too old to be representative of the current situation. The lack of more up to date maps meant change could not be assessed.

Physical structure

There are no anthropogenic activities known to have significantly affected the creeks and pans in the saltmarsh since designation and no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. The physical structure (creeks and pans) indicator therefore passed its target. The assessment of this indicator was based on expert judgment. Confidence in the indicator pass was reduced to medium as the size of the feature is large and it is difficult to be certain of impacts in this SAC in the absence of specific monitoring data.

Hydrodynamic processes and topography

The hydrodynamic and sediment transport processes, and the topography of the feature indicators were assessed as passing their targets as currently there are no known anthropogenic activities that would have significantly altered these aspects. This assessment was based on expert judgement and knowledge of assessments of plans and projects in and near the SAC. This reduced the confidence in the assessment to medium, as it is difficult to be certain of impacts to the condition of the feature in the absence of data. In future, Lidar data could potentially be used to quantify changes in topography.

Water and air quality

It has been estimated that approximately 21% of the ASM feature within the SAC falls within five WFD waterbodies. The upper marsh areas are above the high-water mark and are therefore outside of the WFD waterbody boundary. However, marine water input to the upper marsh will be from these waterbodies therefore these waterbodies are likely to be a good reflection of the overall effect of water quality on the feature. However, as the WFD

water quality sampling is not focused on saltmarshes, the confidence has been reduced in all of the relevant water quality assessments.

Contaminants

One of the four WFD waterbodies that overlap with the ASM feature has a fail for chemicals in the 2024 cycle 3 interim classification. The failure was in the Mawddach waterbody, which failed for PBDE. Compared to other WFD waterbodies that overlap with the feature, this waterbody overlaps with a comparatively large proportion of the feature across the whole SAC (13%). This caused the contaminants indicator to fail. The human health protection goal that is used for PBDE may be considered as over precautionary as the effect of contaminants on the biota of the ASM feature are not fully understood.

One WFD waterbody, Dyfi / Leri, has a pass for chemicals in the 2024 cycle 3 interim classification. However, the chemical classifications were rolled forward from the 2021 cycle 3 classification. This waterbody overlaps with 4% of the feature. The other two WFD waterbodies were not classified as the chemicals have not been assessed within the last six years. Combined, these overlap with 4% of the feature. Overall, the confidence in the failure was reduced to medium due to this and because the human health standard has been used for PBDE. In addition, the impact of the failing contaminants on the feature are not fully understood. The target weighting of the indicator is tertiary to reflect this.

Nutrients (DIN only) and opportunistic macroalgae

The targets for the nutrients (DIN only) and opportunistic macroalgae indicators were met. A medium confidence was attributed to the pass for both indicators as WFD water quality sampling is not focused on saltmarshes. In addition, as some waterbody classifications for the DIN and opportunistic macroalgae elements for were rolled forward from previous cycles. The nutrients indicator (DIN only) was given a tertiary weighting as the effects of high nutrient levels on the ASM feature are not fully understood.

Air quality

High levels of nitrogen deposition from the atmosphere can have a detrimental impact on saltmarsh since they are nitrogen limited. The nitrogen deposition within the SAC, where data were available, was under 10 kg N per ha per year for all saltmarshes and therefore, did not exceed the critical load of 20 kg N per ha per year (APIS), resulting in this indicator to pass with high confidence.

Species and communities

This is a key indicator to inform on the condition of the feature. The analysis of transect data from WFD showed that overall, ASM plant species richness was good for the Artro waterbody and slightly poorer for the Dyfi / Leri waterbody. Species richness is one element to assess the condition of saltmarsh communities across the feature, but more analysis is required to pass the abundance, distribution and species composition of communities indicator. Additionally, there are no WFD sampling stations for the saltmarshes in the Mawddach, Glaslyn and Dwyryd estuaries. These sectors represent a large proportion of the ASM feature in the Pen Llŷn a`r Sarnau SAC. For these reasons, the indicator has been assessed as unknown. Recent visual observations of some areas within the ASM feature (see vegetation structure) has identified some areas of the

saltmarshes that are heavily grazed. This is likely to have an impact on the species composition of the ASM feature, however no information is available to confirm it.

Vegetation structure

Sward height

While a proportion of the feature is in good condition, heavy grazing occurred in the past in a significant section of saltmarsh in the Mawddach estuary and a few locations in the Dwyryd estuary (Sherry and Douglas, in draft). This resulted in a failure in the 2011 condition assessment (Lewis, 2011).

Recent visual observations made in the Mawddach estuary in November 2024 found a significant section of the of the Mawddach saltmarsh between Morfa Friog and Morfa Mawddach to be very close cropped with very low sward height and poor structure observed (H. Lewis (NRW), pers. comm.) (Figure 5a). Within the Dwyryd estuary, recent visual observations made in October 2024 identified some areas of the saltmarshes that remain heavily grazed (H. Lewis (NRW), pers. comm.) (Figure 5b). In the eastern part of the Glastraeth section of the Dwyryd saltmarsh few sheep were seen but visible tracks were observed (viewed from the footpath). The low number of sheep could be seasonal as numbers are typically reduced in Autumn. In this area, the sward height was around 5-10 cm in the upper marsh which is acceptable. However, a reduction in sward height was observed seaward. Further west of this area in the Glastraeth marsh, the sward height was very close cropped and scarcely measurable in parts, with sward heights as low as 1 cm in places. There were estimated to be around 150-200 Canada Geese visible in this area at the time of the visit in October, however, 200 geese would equate to a low level of livestock units. In addition to recent evidence, a study of coastal agricultural landscapes found that out of the Welsh saltmarshes considered to be intensively grazed, most were located in the Dwyryd estuary. These were identified in recent stakeholder interviews, with marshes further up the estuary reported to be more intensively grazed (McKinley et al., 2022). As a result, the sward height indicator has been assessed as failing. Confidence was reduced to medium because the assessment was based on expert judgment and visual inspection rather than a targeted survey.

Figure 5. Visual observations of overgrazing within the ASM feature in Pen Llŷn a`r Sarnau SAC. a) In the Mawddach estuary (Nov 2024), b) in the Dwyryd estuary (Oct 2024).

© Heather Lewis (NRW).

Zonation of vegetation

The analysis of WFD data indicated that the zonation of vegetation was changing but it was deemed to be within the bounds of natural variation. Some changes were observed for the Dyfi / Leri waterbody between the mid-low and upper zone, but these are likely due to natural channel variation. The confidence in the assessment was reduced to medium since WFD data were only available for three out of six WFD waterbodies with some saltmarshes not being assessed. In addition, the changes in zonation were estimated by comparing 2011 and 2019 extents for one out of three WFD waterbodies. Further data and ground truthing investigations would be needed to increase confidence. There was also some uncertainty with the decrease in extent for the pioneer zone. The pioneer zone is difficult to assess by aerial imagery due to the characteristic sparse nature of *Salicornia* areas. A true extent measurement is unrealistic with this sampling technique. This was also considered in the confidence of the assessment. Further investigation with ground truthing evidence or drone imagery will be needed to adequately assess the extent of the pioneer zone in future.

Invasive non-native species

The saline conditions of saltmarshes prevent the common terrestrial NNS in Wales becoming established. There have been no new NNS recorded within the ASM feature in PLAS SAC, and any NNS present are not considered to have an impact on the condition of the feature, resulting in both the primary and tertiary targets for the INNS and NNS indicators to be met.

There were, however, some notable records of NNS within the SAC. *G. vermiculophylla* was first found in Wales in the Glaslyn / Dwyryd estuary in 2017, and since then it has been recorded in the Mawddach, and Dyfi estuaries (Mercer and Brazier, 2023). These specimens appeared to have been washed into the marsh with the tides and although they continued to grow, they were not necessarily persistent. For this reason, *G. vermiculophylla* has been judged to not be having an impact on the condition of the ASM feature. In addition, the Japanese knotweed *Fallopia japonica* was found in in the Dwyryd, Mawddach, Glaslyn and Dyfi but mainly at the upper edge of the saltmarsh near roads.

Both INNS and NNS targets passed with a medium confidence as there have been no targeted NNS surveys on saltmarshes, which would be required to fully understand the presence and impacts of any NNS species within the ASM feature.

Reasons for target failure

The assessment of the ASM feature in Pen Llŷn a`r Sarnau SAC failed one primary target and one tertiary target. This resulted in the feature to be assessed as being in **unfavourable** condition. The failing indicators and reasons for failure, if known, are stated below.

Vegetation structure: sward height

This indicator target has a primary weighting. Heavy grazing occurred in the past in some sections of the Dwyryd and Mawddach estuary which was impacting on the structure and function of the ASM feature. This was due to high sheep numbers grazing in some of the marshes. Recent observations (2024) showed that heavy grazing persists in some

marshes in the Dwyryd and the Mawddach estuaries. These management issues have led to the loss of structural diversity in the saltmarsh vegetation with a short sward of less than 5 cm in height.

Water quality: contaminants

This indicator target has a tertiary weighting. The ASM feature in the SAC is partly within one WFD waterbody (Mawddach) that has a fail for chemicals due to PBDE. Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022).

The PBDE in the Mawddach waterbody may be derived from diffuse sources from contaminated waterbody sediments from industry, and point sources from continuous sewage discharge from the water industry. The WFD investigation of the failure in this waterbody is yet to be undertaken. The impact of these chemicals on the ASM feature is not fully understood. PBDE is being managed in the UK and it is hoped that these levels will reduce in time.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the ASM feature. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition. The threats to the condition of the ASM feature in Pen Llŷn a`r Sarnau SAC are stated below.

Unconsented infrastructure

New unconsented infrastructure such as private slipways and coastal defences, modify the coastal environment through changes to micro-topography and hydrodynamics and can lead to loss of the feature extent, and impacts to the flora and fauna associated with it.

Invasive non-native species

The New Zealand pigmyweed *Crassula helmsii* has been found nearby and while it can only persist in area where water is not truly saline, it could possibly be an issue if its distribution expands to the upper saltmarsh transitions.

G. vermiculophylla has the capacity to turn saltmarsh pools anoxic, destroying the pool fauna and flora and can therefore have a detrimental impact on the feature (see further detail in section 3.1).

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Water quality: contaminants

There is the potential for unregulated contaminants (such as PFAS) to increase. This could affect some of the biota of the ASM feature as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024; Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent.
- Changes in air and sea temperature.
- Increases in wave exposure.
- Changes in species distribution.

3.3 Pembrokeshire Marine SAC condition assessment

The Atlantic salt meadows (ASM) feature, also known as saltmarsh, in Pembrokeshire Marine SAC includes saltmarshes within the Milford Haven Waterway (Figure 6). The ASM feature has been assessed against the performance indicators and an overall condition was assigned for the feature.

Figure 6. Map of the ASM feature in Pembrokeshire Marine SAC.
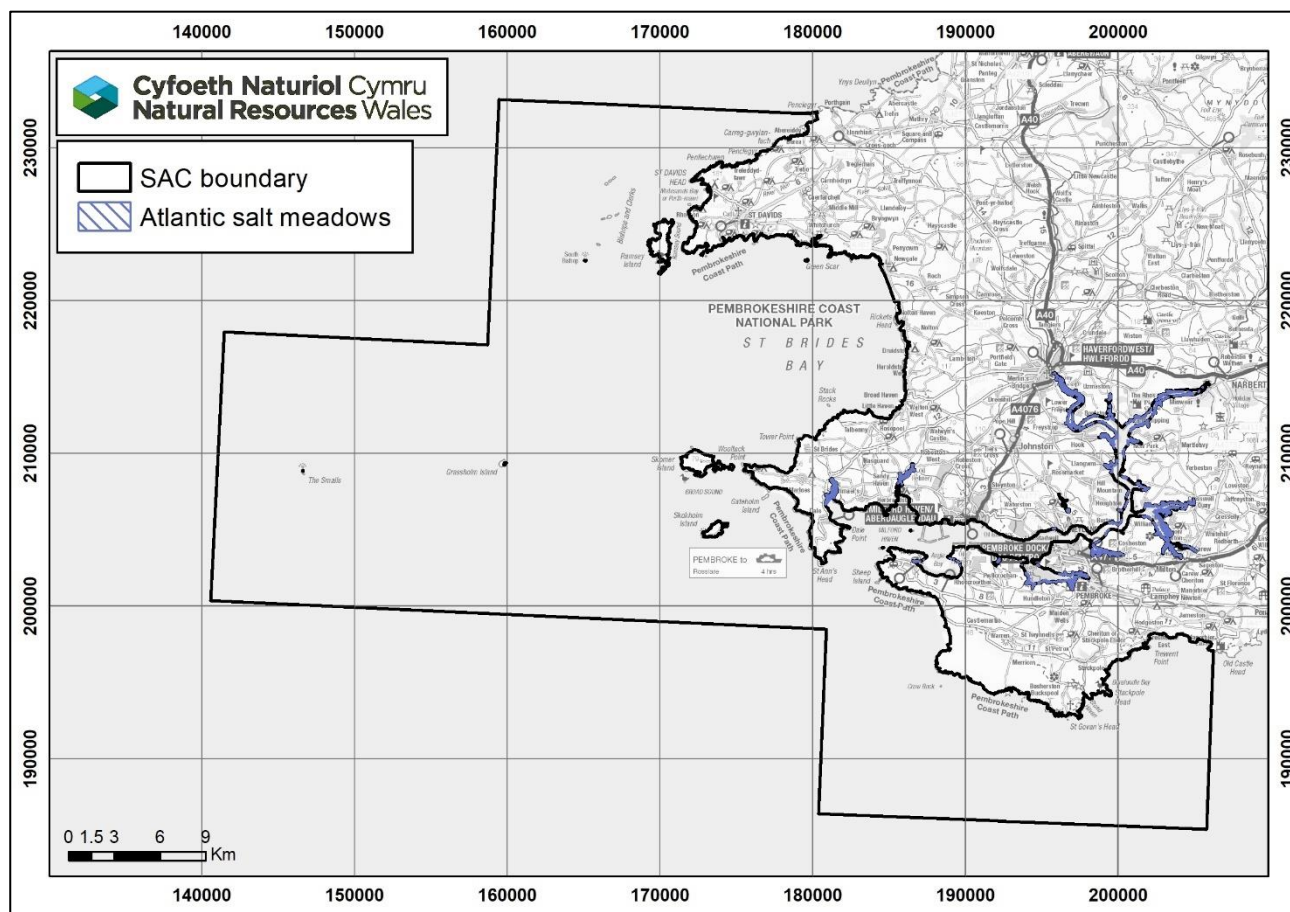
Table 6 has a summary of the assessment outcome against each performance indicator. The outcomes and any reasons for failure are discussed in more detail in the sections below.

Table 6. Condition assessment of the ASM feature in Pembrokeshire Marine SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature extent	The extent of the saltmarsh within the SAC should be stable or increasing, allowing for natural change and variation. (P)	• Between 2000 and 2020, there has been a loss of 0.87 ha (<1%) of saltmarsh extent. This loss is likely within the bounds of natural variation. • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.	**Pass**	Medium
Distribution of feature	Maintain the distribution of saltmarsh throughout the SAC, allowing for natural change and variation. No significant loss from any of the defined sectors. Significant is defined as loss from any sector not to exceed 20%. (P)	• There has been no significant loss of saltmarsh extent in any of the defined sectors. • 5% loss in the Sandy Haven sector. • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.	**Pass**	Medium
Distribution and extent of habitats and communities	Maintain the distribution and extent of saltmarsh habitats and communities, allowing for natural change. (P)	• The available NVC maps date from 1990-2000 and are too old to use for an assessment of distribution and extent.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Physical structure: creeks and pans	Maintain the expected patterns of creeks and pans throughout the SAC, allowing for natural change and variation (P). Artificial drainage channels adversely affecting hydrology are absent or rare. (P)	• There are no anthropogenic impacts known to have significantly affected the creeks and pans in the saltmarsh since SAC designation. • There are currently no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (T)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the saltmarsh. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the saltmarsh. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the EQS. (T)	• One of the three WFD waterbodies that overlaps with the feature was not classified as the chemicals have not been assessed within the last six years (Pickleridge Lagoon). This waterbody overlaps with <1% of the feature. • One WFD waterbody has a pass for chemicals in the 2024 cycle 3 interim classification (Milford Haven Outer). However, some of the chemical classifications were rolled forward from the 2021 cycle 3 classification. This waterbody overlaps with 4% of the feature. • One WFD waterbody has a fail for chemicals (Milford Haven Inner), due to PBDE and PAH. It overlaps with 44% of the feature. • Confidence is medium as the human health standard has been used for PBDE; some waterbodies were not classified for relevant chemicals; and WFD water quality sampling is not focused on saltmarshes.	**Fail**	Medium
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• One of the three overlapping WFD waterbodies was not classified for the DIN WFD element in the 2024 cycle 3 interim classification (Pickleridge Lagoon). Evidence from the Planned Investigation in Pickleridge Lagoon found that there were elevated nutrients and the waterbody would classify as Bad status in 2023. • The other two WFD waterbodies were classified with a Poor status for DIN (Milford Haven Inner and Milford Haven Outer). Combined, these waterbodies overlap with 48% of the feature. • Confidence is medium as WFD water quality sampling is not focused on saltmarshes.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the three WFD waterbodies was not classified for the opportunistic macroalgae WFD element in the 2024 cycle 3 interim classification (Pickleridge Lagoon). • One WFD waterbody was classified as Good status for this WFD element (Milford Haven Outer). It overlaps with 4% of the feature. However, there has been localised growth of opportunistic macroalgae recorded in some of the bays and inlets of the Milford Haven Outer waterbody. • One WFD waterbody was classified with a Moderate status (Milford Haven Inner). This waterbody overlaps with 44% of the feature. There are widespread issues with opportunistic macroalgae in this waterbody. ○ The opportunistic macroalgae is outcompeting the saltmarsh within this waterbody. The WFD investigation has confirmed the failure, with widespread issues in the waterbody which correspond to areas within the ASM feature, raising the confidence in the fail. • Confidence is high because the evidence of the opportunistic macroalgae issues in the Milford Haven Inner waterbody is substantial	**Fail**	High
Air quality	Nitrogen deposition should not exceed the critical load range of 10-20 kg N per ha^{-1} per year. (S)	• Nitrogen deposition within the SAC (where data were available) was under 15 kg N per ha per year for all saltmarshes and did not exceeded the upper range of the critical load on average (APIS). • Confidence is medium as the pass is based on the upper range of the critical load of nitrogen deposition.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, structure and diversity of ASM plant communities within the sectors of the SAC, allowing for natural change and variation. (P)	• Some WFD Regulations monitoring data are available for the Milford Haven Inner and Milford Haven Outer waterbodies but not enough to assess the indicator.	**Unknown**	N/A
Vegetation structure: sward height	Maintain the expected structural variation within the sward height, allowing for natural change and variation. The majority of plants should be able to produce flowers and set seed. (P)	• No significant grazing issues impacting the ASM feature were identified. • The confidence is high due to the availability high quality data.	**Pass**	High
Vegetation structure: zonation of vegetation	Maintain the expected range of saltmarsh zonation for the SAC, allowing for natural change and variation. (P)	• WFD data analysis indicated small changes in zonation, but it was judged to be from natural variation. • Confidence is medium as the changes in zonation were estimated by comparing 2011 and 2019 extents for two of the three relevant WFD waterbodies.	**Pass**	Medium
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence of INNS presence within the ASM feature. • Confidence is medium as the spread and impacts of any INNS present within the SAC are not well understood, and there have been no targeted surveys of NNS within the ASM feature.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There are no known records of NNS within the ASM feature. • Confidence is medium as there have been no targeted surveys for NNS within the ASM feature.	**Pass**	Medium

Assessment conclusions

The Atlantic salt meadow (ASM) feature in Pembrokeshire Marine SAC has been assessed as being in **unfavourable** condition (low confidence). There were a number of indicators with failing targets (Table 7). There are serious concerns over the widespread issues with opportunistic macroalgae in the Milford Haven Inner waterbody, and the subsequent impact on the saltmarsh. The substantial evidence and the fact most of the feature is within areas that correspond to the opportunistic macroalgae growth, resulted in an overall unfavourable outcome. There were also limited or absent data for three key indicators to inform on the condition of the feature (see evidence gaps section 5). This has reduced the confidence in the assessment conclusion. Further investigation is needed to better understand all of the failures to be able to identify management options that can bring the feature back into favourable condition.

A summary of the assessment can be seen in Table 7 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 7. Summary of the condition assessment for the ASM feature in Pembrokeshire Marine SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Pembrokeshire Marine	**Unfavourable (low confidence)**	Water quality: opportunistic macroalgae (S) Water quality: nutrients (DIN only) (T) Water quality: contaminants (T)	• There has been opportunistic macroalgae growth in the Milford Haven Inner waterbody. • Nutrient levels are high in the Milford Haven Inner and Milford Haven Outer waterbodies. • Levels of PBDE and PAH in the Milford Haven Inner waterbody are failing to meet their relevant EQSs.	• Unconsented infrastructure • INNS • Critical load for nitrogen deposition • Water quality: contaminants • Climate change

Detailed assessment information

Extent and distribution

Saltmarsh extent has been mapped using imagery from 2000 and 2020. The total extent of saltmarsh was measured as 296.17 ha in 2020 compared to 297.01 ha in 2000, indicating a total loss of 0.87 ha (<1%). This loss is likely within the bounds of natural variation, therefore this indicator has been assessed as passing. There has been no significant loss of more than 20% of saltmarsh extent in any of the defined sectors. The extent of the saltmarsh has increased in four of the 12 defined sectors, and there has been no change in four. There has been a minor loss in extent in four sectors. The sector with the largest loss is Sandy Haven which has lost approximately 5% of the extent. Both the feature extent and distribution of the feature indicators met their targets. The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.

The distribution and extent of habitats and communities, a key indicator to inform on the condition of the feature, was assessed as unknown as the available NVC mapping dates from 2002 (Prosser and Wallace, 2003). These were deemed too old to be representative of the current situation. The lack of more up to date maps meant change could not be assessed.

Physical structure

There are no anthropogenic activities known to have significantly affected the creeks and pans in the saltmarsh since designation and no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. The physical structure (creeks and pans) indicator therefore passed its target. The assessment of this indicator was based on expert judgment. While there is no evidence of any significant incidents affecting the physical structure in recent years, confidence in the indicator pass was reduced to medium as the size of the feature is large and it is difficult to be certain of impacts in this SAC in the absence of specific monitoring data.

Hydrodynamic processes and topography

The hydrodynamic and sediment transport processes, and the topography of the feature indicators were assessed as passing their targets as currently there are no known anthropogenic activities that would have significantly altered these aspects. This assessment was based on expert judgement and knowledge of assessments of plans and projects in the SAC which has reduced the confidence in the assessment to medium, as it is difficult to be certain of impacts to the condition of the feature in the absence of data. In future, Lidar data could potentially be used to quantify changes in topography.

Water and air quality

It has been estimated that approximately 49% of the ASM feature within the SAC falls within three WFD waterbodies. The upper marsh areas are above the high-water mark and are therefore outside of the WFD waterbody boundary. However, marine water input to the upper marsh will be from these waterbodies therefore these waterbodies are likely to be a good reflection of the overall effect of water quality on the feature. However, as the WFD

water quality classifications are not focused on saltmarshes, the confidence has been reduced in the relevant water quality assessments.

Contaminants

The Milford Haven Inner waterbody has a fail for chemicals in the 2024 cycle 3 interim classification, where PBDE and PAH failed. This waterbody overlaps with the largest proportion of the ASM feature (44%). PBDE has failed in this waterbody in all previous cycles. The human health protection goal that is used for PBDE may be considered as over precautionary as the effect of contaminants on the biota of the ASM feature are not fully understood. The Milford Haven Outer waterbody failed for mercury and TBT in previous cycles. This waterbody now passes for chemicals in the 2024 cycle 3 interim classification, however TBT, which was previously a failing chemical, is no longer assessed. In addition, mercury was not classified in the 2024 cycle 3 interim classification. The other WFD waterbody (Pickleridge Lagoon) was not classified as the chemicals have not been assessed within the last six years. The failure of the Milford Haven Inner waterbody caused the contaminants indicator to fail. The confidence in the fail was reduced to medium because the human health standard has been used for PBDE, and due to the unclassified waterbodies for chemicals. In addition, the impact of the failing contaminants on the feature are not fully understood. The target weighting of the indicator is tertiary to reflect this.

Nutrients (DIN only) and opportunistic macroalgae

The nutrients indicator failed to meet its target as failing levels of DIN have been recorded in two of the three WFD waterbodies that overlap with the ASM feature. The Milford Haven Inner and Milford Haven Outer waterbodies were classified with a Poor status for DIN in the 2024 cycle 3 interim classification. Combined, these overlap with 48% of the feature. These waterbodies also failed in previous cycles, and the Milford Haven Outer waterbody has deteriorated from Moderate status in the 2021 cycle 3 classification. The WFD investigation reports of these waterbodies confirmed the DIN failures in the 2018 cycle 2 interim and 2021 cycle 3 classifications (Lock, 2021a; Lock, 2021b). The Milford Haven Inner waterbody has also been designated by Welsh Government as a sensitive area (eutrophic) under the Urban Wastewater Treatment Regulations. The opportunistic macroalgae failure was also confirmed in the WFD investigation of the Milford Haven Inner waterbody (Lock, 2021a). Evidence from a planned investigation concluded that the third WFD waterbody, Pickleridge Lagoon, would classify as Bad status for DIN in 2023 due to elevated nutrients. Nutrient issues have been confirmed from investigations. Confidence in the fail was reduced to medium as WFD water quality sampling is not focused on saltmarshes. The nutrients indicator (DIN only) was given a tertiary weighting as the effects of high nutrient levels on the ASM feature are not fully understood.

The opportunistic macroalgae indicator failed to meet the target due to the Moderate status classification for this element in the Milford Haven Inner waterbody in the 2024 cycle 3 interim classification. The WFD investigation report confirmed the opportunistic macroalgae failure (Lock, 2021a), in which extensive and recurring coverage has been recorded in various inlets, with many of the areas corresponding to areas within the ASM feature (Figure 7). In some areas, the opportunistic macroalgae is impacting the saltmarsh, growing on pioneer saltmarsh (Figure 8) (Lock, 2021a). There has been evidence of opportunistic macroalgae growth since 2007, indicating that this has been a long-lasting issue within the Milford Haven Inner waterbody. There are no quantitative data available on the anoxic layers from these surveys, however WFD surveyors have noted anoxic

layers within 2cm of the surface beneath opportunistic macroalgae (Lock, 2021a). This is indicative of disturbance to the underlying benthos and may impact the ASM feature.

Figure 7. Opportunistic macroalgae cover in Milford Haven Inner waterbody in 2022, mapped against the ASM feature within the waterbody.
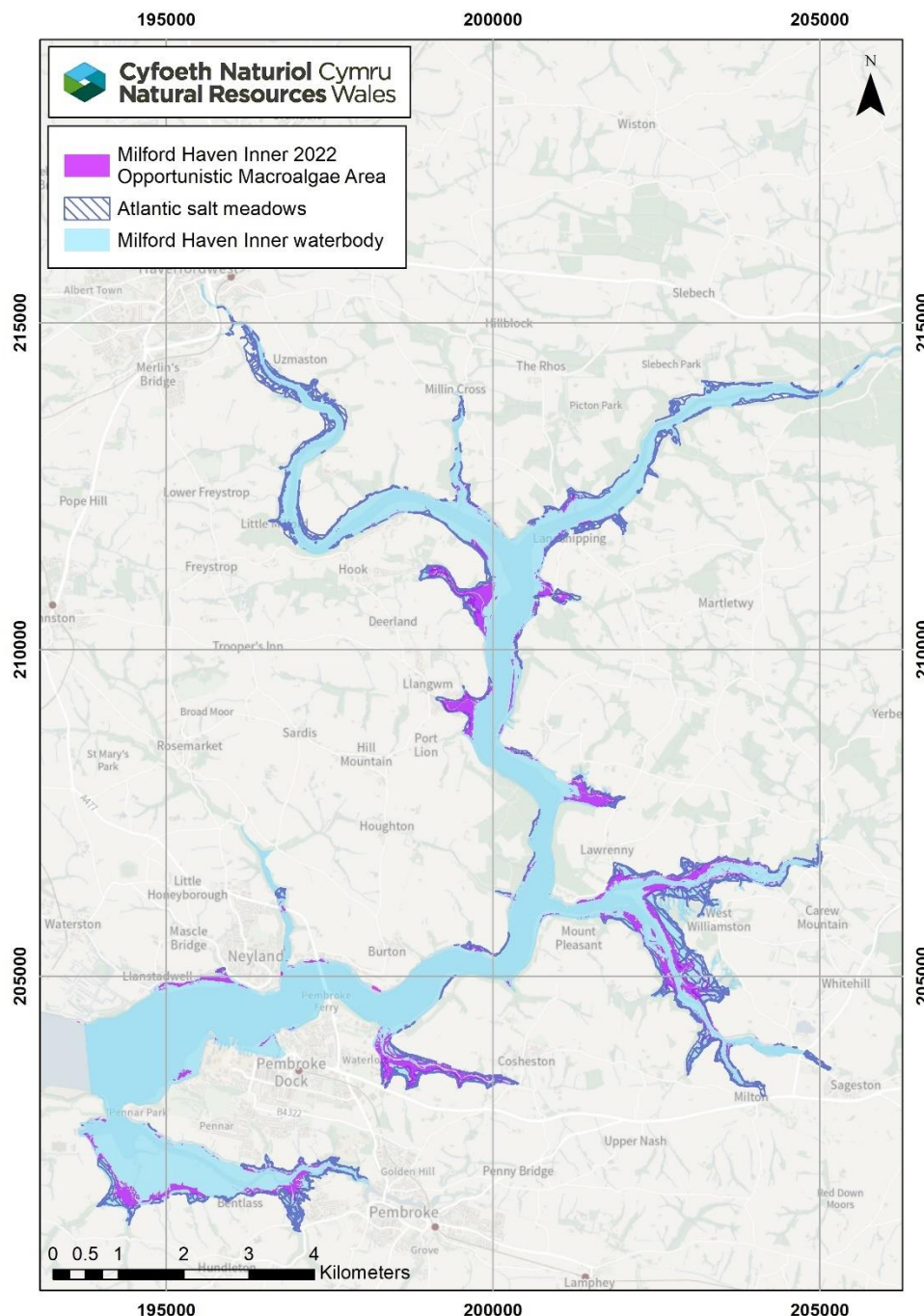
The Milford Haven Outer waterbody was classified with a Good status in the 2024 cycle 3 interim classification. Although the opportunistic macroalgae is not a failing element for this waterbody, there have been localised issues recorded in the more sheltered bays and inlets including Angle Bay, Sandy Haven and Dale Gann (Lock, 2021b). The other WFD waterbody (Pickleridge Lagoon) was not classified for this element in the 2024 cycle 3 interim classification. Some WFD waterbodies are not assessed for opportunistic

macroalgae as they do not have suitable substratum (i.e. areas of intertidal habitat for opportunistic macroalgal growth).

Overall, a high confidence was attributed to the failure of this indicator, as the failing WFD waterbody overlaps with the largest proportion of the feature (44%), and because the evidence of the opportunistic macroalgae issues in the Milford Haven Inner waterbody is substantial, especially within the ASM feature.

Figure 8. Opportunistic macroalgae covering pioneer saltmarsh plants in Garron Pill, Milford Haven Waterway in 2018 (Lock, 2021a).

Air quality

High levels of nitrogen deposition from the atmosphere can have detrimental impact on saltmarsh since they are nitrogen limited. The nitrogen deposition within the SAC, where data were available, was under 15 kg N per ha per year for all saltmarshes and therefore did not exceed the upper range of the critical load (20 kg N per ha per year, APIS). If the assessment was based on the lower range of the critical load (10 kg N per ha per year), the indicator would fail to meet its target. For this reason, confidence was reduced to medium.

Species and communities

Whilst some WFD Regulations monitoring data are available for the Milford Haven Inner and Milford Haven Outer waterbodies, these were not sufficient to assess this indicator as no transect data were available. No further analyses have been carried out to look at distinctive elements such as abundance, distribution and species composition. This is a key indicator to inform on the condition of the feature. As a result, the abundance, distribution and species composition of communities indicator has been assessed as unknown.

Vegetation structure

Both the sward height and zonation of vegetation indicators met their targets. No significant grazing issues were identified (Sherry and Douglas, in draft). There were some local cases of excessive cattle poaching on saltmarshes, but they have all been addressed

and the marshes are recovering. For the sward height indicator, the confidence in the pass is high due to the availability of high quality data. WFD data analysis showed small changes in zonation pattern, but this is likely to be natural and of limited concern. The confidence in the assessment for the zonation of vegetation indicator was reduced to medium since the changes in zonation derived from WFD data were estimated by comparing 2011 and 2019 extents for two out of three WFD waterbodies. Further data and ground truthing investigations would be needed to increase confidence.

Invasive non-native species

The saline conditions of saltmarshes prevent the common terrestrial NNS in Wales becoming established. There are no known records of NNS within the ASM feature, resulting in both the primary and tertiary targets for the INNS and NNS indicators to be met.

There were, however, some notable records of NNS within the SAC. The American Skunk cabbage *Lysichiton americanus* has been recorded in the estuary, but this is not yet on the saltmarsh and likely to only reach the margins.

Both the primary and tertiary targets for the INNS and NNS indicators passed with a medium confidence as there have been no targeted NNS surveys on saltmarshes, which would be required to fully understand the presence and impacts of any NNS species within the ASM feature.

Reasons for target failure

The assessment of the ASM feature in Pembrokeshire Marine SAC failed one secondary target and two tertiary targets. Due to the concerns over the failing secondary opportunistic macroalgae indicator, this resulted in the feature to be assessed as being in **unfavourable** condition. The failing indicators and reasons for failure, if known, are stated below.

Water quality: opportunistic macroalgae

This indicator target has a secondary weighting. The magnitude of the opportunistic macroalgae issue in the ASM feature was the main reason for unfavourable condition. The Milford Haven Inner waterbody was classified as Moderate status for the opportunistic macroalgae element in the 2024 cycle 3 interim classification. The WFD investigation report confirmed the opportunistic macroalgae failure in this waterbody, where it has been photographed and observed on saltmarsh habitats (Lock, 2021a).

Major input of nutrients was found to be from diffuse sources associated with farm infrastructure and probable losses from agricultural land (Haines and Edwards, 2016; Lock, 2021a). In addition, point source continuous sewage discharge from the water industry were confirmed as a major source of nutrients linked to the opportunistic macroalgae failure, but only a minor source for the DIN failure (Haines and Edwards, 2016; Caprez, 2020; Lock, 2021a). Intermittent and domestic sewage are also suspected in the catchment. Further investigation locally is required to confirm these.

Water quality: nutrients (DIN only)

This indicator target has a tertiary weighting. The nutrients indicator failed to meet its target as high levels of DIN have been recorded in all three of the WFD waterbodies that overlap with the ASM feature. The Milford Haven Inner and Outer waterbodies overlap with the largest proportion of the feature. These were classified with a Poor status for the DIN element in the 2024 cycle 3 interim classification. The WFD investigation reports have confirmed elevated nutrients in these waterbodies, where it was concluded that major input of nutrients is likely to be derived from diffuse sources associated with farm infrastructure and probable losses from agricultural land (Haines and Edwards, 2016; Lock, 2021a; Lock, 2021b). The Milford Haven Inner waterbody has also been designated by Welsh Government as a sensitive area (eutrophic) under the Urban Wastewater Treatment Regulations. Further investigation is required to determine the breakdown of nutrient sources into the catchments. Point source continuous sewage discharge from the water industry was confirmed as minor source of nutrients linked to the DIN failures (Haines and Edwards, 2016; Caprez, 2020; Lock, 2021a; Lock, 2021b). Intermittent and domestic sewage are also suspected in the catchments. Further investigation locally is required to confirm these. A planned investigation in the Pickleridge Lagoon has also found elevated nutrients (Jopson and Lindenbaum, 2023).

Water quality: contaminants

This indicator failed to meet its tertiary target. A large proportion of the ASM feature overlaps with the Milford Haven Inner waterbody, which has a fail for chemicals due to PBDE and PAH. Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022). PAHs can be produced through natural processes, but also arise from anthropogenic sources, for example during combustion of fossil fuels and organic material (Webster and Fryer, 2022).

The contaminants in the water column may be derived from diffuse sources from contaminated waterbody bed sediments, or point sources from continuous sewage discharge from waste water treatment. However, a WFD investigation of the failure in Milford Haven Inner waterbody is yet to be undertaken. PBDE is being managed in the UK and it is hoped that levels will reduce in time. There is currently no specific management in place for PAH in Wales. The PAH EQS is based on the most sensitive taxa and may not be applicable to all of the biota of the ASM feature. The impact of PAH on the condition of the ASM feature is not fully understood.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the ASM feature. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition. The threats to the condition of the ASM feature in Pembrokeshire Marine SAC are stated below.

Unconsented infrastructure

New unconsented infrastructure especially in the Pembrokeshire Marine SAC, such as private slipways and coastal defences, modify the coastal environment through changes to

micro-topography and hydrodynamics and can lead to loss of the feature extent, and impacts to the flora and fauna associated with it.

Invasive non-native species

The presence of *L. americanus* which can tolerate brackish conditions has been recorded in the estuary but not yet on the saltmarsh. It is possible that this species could establish on the saltmarsh, but this has not happened yet.

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Critical load for nitrogen deposition

The saltmarsh habitat is sensitive to nitrogen deposition from the atmosphere, so it is important that the current level of nitrogen deposition does not exceed the critical load of 10-20 kg N per ha per year. Although current critical load levels of nitrogen deposition were not exceeded for the ASM feature in the Pembrokeshire Marine SAC, the air quality indicator would fail if it was assessed against the lower range of the critical load (e.g. 10 kg N per ha per year).

Water quality: contaminants

There is the potential for unregulated contaminants (such as PFAS) to increase. This could affect some of the biota of the ASM feature as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024; Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent.
- Changes in air temperature.
- Increases in wave exposure.
- Changes in species distribution.

The latest information (Oaten et al, 2024) shows that the ASM feature in this SAC is definitely under threat of coastal squeeze and natural squeeze (loss of habitat against high ground).

3.4 Carmarthen Bay and Estuaries SAC condition assessment

The Atlantic salt meadows (ASM) feature, also known as saltmarsh, in Carmarthen Bay and Estuaries SAC includes saltmarshes from the Burry Inlet, Loughor and the Three Rivers estuaries (Figure 9). The ASM feature has been assessed against the performance indicators and an overall condition was assigned for the feature.

Figure 9. Map of the ASM feature in Carmarthen Bay and Estuaries SAC.
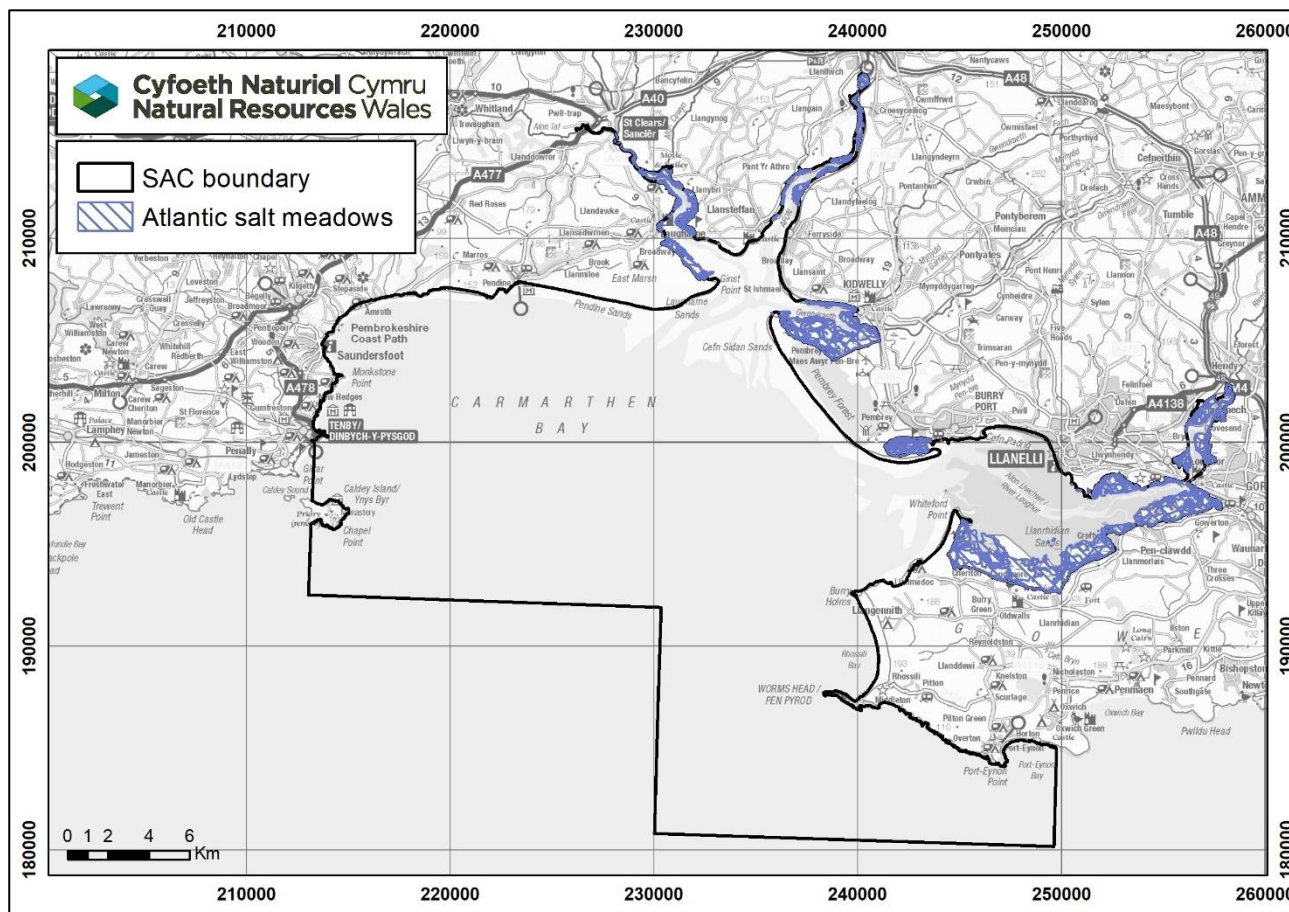
Table 8 has a summary of the assessment outcome against each performance indicator. The outcomes and any reasons for failure are discussed in more detail in the sections below.

Table 8. Condition assessment of the ASM feature in Carmarthen Bay and Estuaries SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature extent	The extent of the saltmarsh within the SAC should be stable or increasing, allowing for natural change and variation. (P)	• Between 2000 and 2020-2021, there has been a gain of 98.65 ha (3.5%) of saltmarsh extent. • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.	**Pass**	Medium
Distribution of feature	Maintain the distribution of saltmarsh throughout the SAC, allowing for natural change and variation. No significant loss from any of the defined sectors. Significant is defined as loss from any sector not to exceed 20%. (P)	• There has been no significant loss of saltmarsh extent in any of the defined sectors. • 5% loss in the Taf sector (Three Rivers). • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. This, and the possible coastal squeeze in the Taf sector has reduced the confidence in the pass to low.	**Pass**	Low
Distribution and extent of habitats and communities	Maintain the distribution and extent of saltmarsh habitats and communities, allowing for natural change. (P)	• The available NVC maps date from 1997-1998 and are too old to use for an assessment of distribution and extent.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Physical structure: creeks and pans	Maintain the expected patterns of creeks and pans throughout the SAC, allowing for natural change and variation (P). Artificial drainage channels adversely affecting hydrology are absent or rare. (P)	• Minor, localised creek damage has been historically recorded in some areas within the SAC. These small and localised impacts are not likely to lead to significant change in the structure and function of the creeks and pans across the feature. • Some of the damage to the creeks and pans includes creek in-filling with rubble for access for cockling or agricultural activities, creation of artificial drainage channels, and creek erosion from farming or grazing activity (trampling). The artificial drainage channels are not considered to be adversely affecting the hydrology within the saltmarsh. • Confidence is medium as these issues are small and localised within the large feature area in the SAC, but the full extent of these issues is unknown. In addition, the evidence is from an older survey (2012).	**Pass**	Medium
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (T)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the saltmarsh. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the saltmarsh. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the EQS. (T)	• All three of the WFD waterbodies that overlap with the feature have a pass for chemicals in the 2024 cycle 3 interim classification (Burry Inlet Outer, Burry Inlet Inner and Three Rivers Estuary). In all WFD waterbodies, some or all of the chemical classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. • Confidence is medium as the human health standard has been used for PBDE; some waterbodies have rolled forward classifications; and WFD water quality sampling is not focused on saltmarshes.	**Pass**	Medium
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• One of the three overlapping WFD waterbodies was classified as Good status for the DIN WFD element in the 2024 cycle 3 interim classification (Burry Inlet Outer). This waterbody overlaps with 8% of the feature. It was classified with a Moderate status in the 2021 cycle 3 classification, and has fluctuated between Good and Moderate status in previous cycles. • The other two WFD waterbodies were classified with a Moderate status for DIN (Burry Inlet Inner and Three Rivers Estuary). Combined, these overlap with 13% of the feature. • Confidence is medium as WFD water quality sampling is not focused on saltmarshes.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• None of the three WFD waterbodies that overlap with the feature have been classified for the opportunistic macroalgae WFD element in the 2024 cycle 3 interim classification.	**Unknown**	N/A
Air quality	Nitrogen deposition should not exceed the critical load range of 10-20 kg N per ha^{-1} per year. (S)	• Nitrogen deposition within the SAC (where data were available) was under 17 kg N per ha per year for all saltmarshes and did not exceed the upper range of the critical load on average (APIS). • Confidence is medium as the pass is based on the upper range of the critical load of nitrogen deposition.	**Pass**	Medium
Abundance, distribution and species composition of communities	Maintain the abundance, distribution, structure and diversity of ASM plant communities within the sectors of the SAC, allowing for natural change and variation. (P)	• The analysis of WFD transect data showed that overall, ASM plant species richness was good for the Taf waterbody. • Species richness is only one element to assess the condition of saltmarsh communities across the feature. • No WFD sampling stations are available for the rest of the feature, therefore this indicator was assessed as unknown. • Heavy grazing in some areas within the ASM feature are likely to impact the species composition, however no information is available to confirm this.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Vegetation structure: sward height	Maintain the expected structural variation within the sward height, allowing for natural change and variation. The majority of plants should be able to produce flowers and set seed. (P)	• Heavy grazing occurs in various locations across the feature and particularly on the south side of the estuary. • Some areas are also under-grazed. • Confidence is high due to the extensive evidence of grazing issues within the feature.	**Fail**	High
Vegetation structure: zonation of vegetation	Maintain the expected range of saltmarsh zonation for the SAC, allowing for natural change and variation. (P)	• WFD data analysis indicated some changes in zonation, but it was judged to be from natural variation. • Confidence is medium as the changes in zonation were estimated by comparing 2011 and 2019 extents for two of the three relevant WFD waterbodies.	**Pass**	Medium
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence of INNS presence within the ASM feature. • Confidence is medium as the spread and impacts of any INNS present within the SAC are not well understood, and there have been no targeted surveys of NNS within the ASM feature.	**Pass**	Medium
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There are no known records of NNS within the ASM feature. • Confidence is medium as there have been no targeted surveys for NNS within the ASM feature.	**Pass**	Medium

Assessment conclusions

The Atlantic salt meadow (ASM) feature in Carmarthen Bay and Estuaries SAC has been assessed as being in **unfavourable** condition (low confidence). There were a couple of indicators with failing targets (Table 9). There were also limited or absent data for three key indicators to inform on the condition of the feature (see evidence gaps section 5). This has reduced the confidence in the assessment conclusion. Further investigation is needed to better understand all of the failures to be able to identify management options that can bring the feature back into favourable condition.

A summary of the assessment can be seen in Table 9 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 9. Summary of the condition assessment for the ASM feature in Carmarthen Bay and Estuaries SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Carmarthen Bay and Estuaries	**Unfavourable (low confidence)**	Vegetation structure: sward height (P) Water quality: nutrients (DIN only) (T)	• There is heavy grazing by sheep in several locations across the feature. • High nutrient levels have been recorded in the Burry Inlet Inner and Three Rivers Estuary waterbodies.	• Unconsented infrastructure • Creek and pan infilling • Critical load for nitrogen deposition • Fly grazing • INNS • Coastal squeeze • Water quality: contaminants • Climate change

Detailed assessment information

Extent and distribution

Saltmarsh extent has been mapped using imagery from 2000 and 2020-2021. The total extent of saltmarsh was measured as 2914.41 ha in 2020-2021 compared to 2815.76 ha in 2000, indicating a total gain of 98.65 ha (3.5%). There has been no significant loss of more than 20% of saltmarsh extent in any of the defined sectors. The extent of the saltmarsh has increased in five of the six defined sectors. There has been a 5% loss of extent in the Taf sector (Three Rivers estuary). The loss at the lower marsh is caused by the river altering its course westward in the estuary causing erosion to the edge and showing possible signs of coastal squeeze effects. Both the feature extent and distribution of the feature indicators met their targets. The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. This, and the possible coastal squeeze in the Taf location has reduced the confidence in the pass to low.

The distribution and extent of habitats and communities, a key indicator to inform on the condition of the feature, was assessed as unknown as the available NVC mapping date from 1997-1998 (Prosser and Wallace, 1998; 1999b). These were deemed too old to be representative of the current situation. The lack of more up to date maps meant change could not be assessed.

Physical structure

Historically, localised impacts of creek damage have been recorded in various locations within the ASM feature in the Carmarthen Bay and Estuaries SAC. There have been recent reports (2023) of creek infilling with rubble for access for cockling at Crofty and Llandrhidian. There have also been historical reports of creek damage from a survey done in 2012. These include salt pan infilling and dumping of rock in creeks for cattle crossings in Penclawdd, dumping of rubble in creeks to create passes in Loughor, creation of livestock bridges in creeks and artificial drainage channels in Llangennech, extensive man-made drainage channels in Morfa Uchaf, and localised erosion of banks by horses in Bynea. The evidence of impacts are minor and localised, they are unlikely to be affecting the structure and function of the creeks and pans in the feature as a whole. In addition, the artificial drainage channels are not considered to be adversely affecting the hydrology within the saltmarsh. Therefore this indicator was assessed as passing the target. The confidence in the pass is reduced to medium because some of the evidence is from an old survey (2012), and because the full extent of the damage is unknown. Investigation into the cumulative scale and impact of reported management issues is needed to determine if the structure and function of the saltmarsh is being affected by these. It has therefore been highlighted as a threat.

Hydrodynamic processes and topography

The hydrodynamic and sediment transport processes, and the topography of the feature indicators were assessed as passing their targets as currently there are no known anthropogenic activities that would have significantly altered these aspects. This assessment was based on expert judgement and knowledge of assessments of plans and projects in the SAC which has reduced the confidence in the assessment to medium, as it

is difficult to be certain of impacts to the condition of the feature in the absence of data. In future, Lidar data could potentially be used to quantify changes in topography.

Water and air quality

It has been estimated that approximately 21% of the ASM feature within the SAC falls within four WFD waterbodies. The upper marsh areas are above the high-water mark and are therefore outside of the WFD waterbody boundary. However, marine water input to the upper marsh will be from these waterbodies therefore these waterbodies are likely to be a good reflection of the overall effect of water quality on the feature. However, as the WFD water quality sampling is not focused on saltmarshes, the confidence has been reduced in all of the relevant water quality assessments.

Contaminants

The contaminants indicator met its target as all three of the WFD waterbodies that overlap with the ASM feature have a pass for chemicals in the 2024 cycle 3 interim classification. However, in all three WFD waterbodies, some or all of the chemical classifications were rolled forward from previous cycles as they were not assessed in the 2024 cycle 3 interim classification. The confidence in the fail was reduced to medium due to this, and as WFD water quality sampling is not focused on saltmarshes. The impact of contaminants on the feature are not fully understood. The target weighting of the indicator is tertiary to reflect this.

Nutrients (DIN only) and opportunistic macroalgae

The nutrients indicator (DIN only) failed to meet the target as high levels of DIN have been recorded in two of the three WFD waterbodies that overlap with the ASM feature. These are the Burry Inlet Inner and Three Rivers Estuary waterbodies, which combined overlap with 13% of the feature. The Moderate status for DIN in these waterbodies was confirmed in the 2021 WFD investigation reports (Jones 2021b; Jopson and Newman 2021). There is also a biological response to high nutrient levels in the Burry Inlet Inner waterbody, where phytoplankton was classified with a Moderate status.

The other overlapping WFD waterbody, Burry Inlet Outer, was classified with a Good status for DIN in the 2024 cycle 3 interim classification. This waterbody overlaps with 8% of the ASM feature. It was previously was classified as Moderate in the 2021 cycle 3 classification, but has improved to Good status in the 2024 cycle 3 interim classification. The confidence of this improvement is quite certain (79%). The classification for the Burry Inlet Outer waterbody has fluctuated between Moderate and Good status over various cycles. The supporting biological element, phytoplankton, in the Burry Inlet Outer waterbody is still classified as Moderate status in the 2024 cycle 3 interim classification, despite the improved DIN classification. The WFD investigation report for this waterbody confirmed the DIN and phytoplankton failure in 2021 (Jones 2021c). Investigations have confirmed DIN failures and / or biological responses to elevated nutrients in phytoplankton in the relevant WFD waterbodies, however, due to the improvement in DIN in the Burry Inlet Outer waterbody, and as WFD water quality sampling is not focused on saltmarshes, confidence in the fail was reduced to medium. The nutrients indicator (DIN only) was given a tertiary weighting as the effects of high nutrient levels on the ASM feature are not fully understood.

The indicator for opportunistic macroalgae was assessed as unknown. This was because none of the three WFD waterbodies were classified for the opportunistic macroalgae element in the 2024 cycle 3 interim classification, as no data has been collected for this element over the last six years (see Section 3). Some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum (i.e. areas of intertidal habitat for opportunistic macroalgal growth).

Sheep grazing and the subsequent wash-off of faecal material from the intertidal saltmarsh on the Burry Inlet is believed to be responsible for episodic events of high bacteria concentrations. There was a pollution event in July and August in 2024 at Llangennith, in which there were spikes in *E. coli* (NRW)*.* This was associated with high numbers of grazing sheep at the time.

Air quality

High levels of nitrogen deposition from the atmosphere can have detrimental impact on saltmarsh since they are nitrogen limited. The nitrogen deposition within the SAC, where data were available, was under 17 kg N per ha per year for all saltmarshes and did not exceed the upper range of the critical load (20 kg N per ha per year, APIS). Confidence was reduced to medium as the critical load is based on a range. Nitrogen deposition values for some saltmarshes in the SAC were higher than the mid-range of the critical load. This is concerning and will be something to pay close attention to in the next assessment.

Species and communities

The analysis of transect data from WFD Regulations monitoring showed that overall, ASM plant species richness tended to be good for the Taf waterbody. This is a key indicator to inform on the condition of the feature. As more analysis is required to effectively assess the condition of saltmarsh communities across the feature, the abundance, distribution and species composition of communities indicator was assessed as unknown. Overgrazing is widespread within the feature (see vegetation structure). This is likely to have an impact on the species composition of the ASM feature, however no information is available to confirm it.

Vegetation structure

Sward height

While grazing by livestock play an important role in controlling rank vegetation and improving species diversity of the saltmarsh communities, too much of it can have deleterious effects on the saltmarsh communities. For instance, overgrazing can result in a loss of structural diversity in saltmarsh vegetation, resulting in a short uniformly cropped marsh that may be detrimental to some taxa such as waders and invertebrates (Sherry and Douglas, in draft). Overgrazing is widespread within the feature, especially with high sheep grazing pressure located in the south side of the Loughor / Burry estuary. Locations such as Whiteford Burrows, Llanrhidian, Penclawdd are all grazed and much of it being grazed to a short sward of less than 5 cm in height. Heavy cattle grazing and localised poaching occur on the north of the Three Rivers estuary. There are also areas of the ASM feature that are largely ungrazed, that are now overgrown or have *Phragmites spp.* moving into the saltmarsh area. Most of the ungrazed areas were found on either the Tywi or Taf

estuary. The sward height indicator therefore failed to meet its target with a high confidence due to the extensive evidence of grazing issues within the feature.

Zonation of vegetation

The analysis of WFD data showed that the zonation of vegetation was stable or increasing for the low-mid and upper zone, resulting in a pass for this indicator. The confidence in WFD data was reduced to medium as the changes in zonation were estimated by comparing 2011 and 2019 extents for two out of three WFD waterbodies. Further data and ground truthing investigations would be needed to increase the confidence.

Invasive non-native species

The saline conditions of saltmarshes prevent the common terrestrial NNS in Wales becoming established. There are no known records of NNS within the ASM feature, resulting in both the primary and tertiary targets for the INNS and NNS indicators to be met.

There were, however, some notable records of NNS within the SAC. *G. vermiculophylla* has been recorded in 2021 and 2022 in nearby mudflats and sandflats within the Burry Inlet, and has been found to form dense strands of up to 0.8 ha in the Loughor estuary during ad-hoc surveys. None were seen in the ASM feature. For this reason, *G. vermiculophylla* has been judged to not be having an impact on the condition of the ASM feature, but there is a risk of it being detrimental where present.

Both INNS and NNS targets passed with a medium confidence as there have been no targeted NNS surveys on saltmarshes, which would be required to fully understand the presence and impacts of any NNS species within the ASM feature.

Reasons for target failure

The assessment of the ASM feature in Carmarthen Bay and Estuaries SAC failed one primary target and one tertiary target. This resulted in the feature to be assessed as being in **unfavourable** condition. The failing indicators and reasons for failure, if known, are stated below.

Vegetation structure: sward height

This indicator target has a primary weighting. Heavy grazing occurs within the feature impacting on the structure and function of saltmarshes. This is due to high sheep numbers grazing in the marshes for example around Llanrhidian. These management issues have led to the loss of structural diversity in the saltmarsh vegetation with sward height as short as 1 cm in some places, particularly around Whiteford Burrows where there is no flowering except for *Armeria maritima,* and in some areas around Penclawdd. The heavy grazing in some areas is detrimental to the flowering plants, waders and many invertebrates, but benefits wildfowl presenting a challenge for altering grazing patterns and stocking levels (Sherry and Douglas, in draft).

Water quality: nutrients (DIN only)

This indicator target has a tertiary weighting. High levels of DIN have been recorded in two of the WFD waterbodies that overlap with the ASM feature (Burry Inlet Inner and Three Rivers Estuary). The WFD investigation reports have confirmed elevated nutrients in these waterbodies, where it was concluded that major input of nutrients is likely to be derived from diffuse sources associated with farm infrastructure and probable losses from agricultural land for the Burry Inlet Inner waterbody (Jones 2021b; Jopson and Newman 2021). Point source continuous sewage discharge from the water industry were also confirmed as a source of nutrients linked to the DIN failures for both WFD waterbodies (Jones 2021b; Jopson and Newman 2021). Intermittent and domestic sewage are also suspected in the catchments. Further investigation locally is required to confirm these.

Sheep grazing and the subsequent wash-off of faecal material from the intertidal saltmarsh on the Burry Inlet is believed to be responsible for episodic events of high bacteria concentrations.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the ASM feature. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition. The threats to the condition of the ASM feature in Carmarthen Bay and Estuaries SAC are stated below.

Unconsented infrastructure

New unconsented infrastructure, such as private slipways and coastal defences, modify the coastal environment through changes to micro-topography and hydrodynamics and can lead to loss of the feature extent, and impacts to the flora and fauna associated with it.

Creek and pan infilling

Unconsented alterations to the creeks and pans in the saltmarsh have been reported in various locations within the SAC. Further investigation of these issues is needed, with work to determine if the structure and function of the saltmarsh is being affected and how extensive the impacts are.

Critical load for nitrogen deposition

The saltmarsh habitat is sensitive to nitrogen deposition from the atmosphere, so it is important that the current level of nitrogen deposition does not exceed the critical load of 10-20 kg N per ha per year. Although current critical load levels of nitrogen deposition were not exceeded for the ASM feature in the Carmarthen Bay and Estuaries SAC, the air quality indicator would fail if it was assessed against the lower range of the critical load (e.g. 10 kg N per ha per year).

Fly grazing

Horses that graze on land without the landowner's permission are frequently observed in the Carmarthen Bay and Estuaries SAC. If left unmanaged, horses can cause a lot of damaged to saltmarsh, as has been seen in Bynea.

Invasive non-native species

G. vermiculophylla has the capacity to turn saltmarsh pools anoxic, destroying the pool fauna and flora and can therefore have a detrimental impact on the feature (see further detail in section 3.1).

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Coastal squeeze

The presence of hard structures for coastal flood defence and erosion control within this SAC can prevent the natural landward migration of the saltmarsh, resulting in saltmarsh being squeezed between advancing sea levels and extant hard infrastructure.

Water quality: contaminants

There is the potential for unregulated contaminants (such as PFAS) to increase. This could affect some of the biota of the ASM feature as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024; Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent.
- Changes in air temperature.
- Increases in wave exposure.
- Changes in species distribution.

3.5 Kenfig SAC condition assessment

The Atlantic salt meadows (ASM) feature, also known as saltmarsh, in Kenfig SAC includes saltmarshes from the Ogmore estuary and Kenfig river (Figure 10). The ASM feature has been assessed against the performance indicators and an overall condition was assigned for the feature.

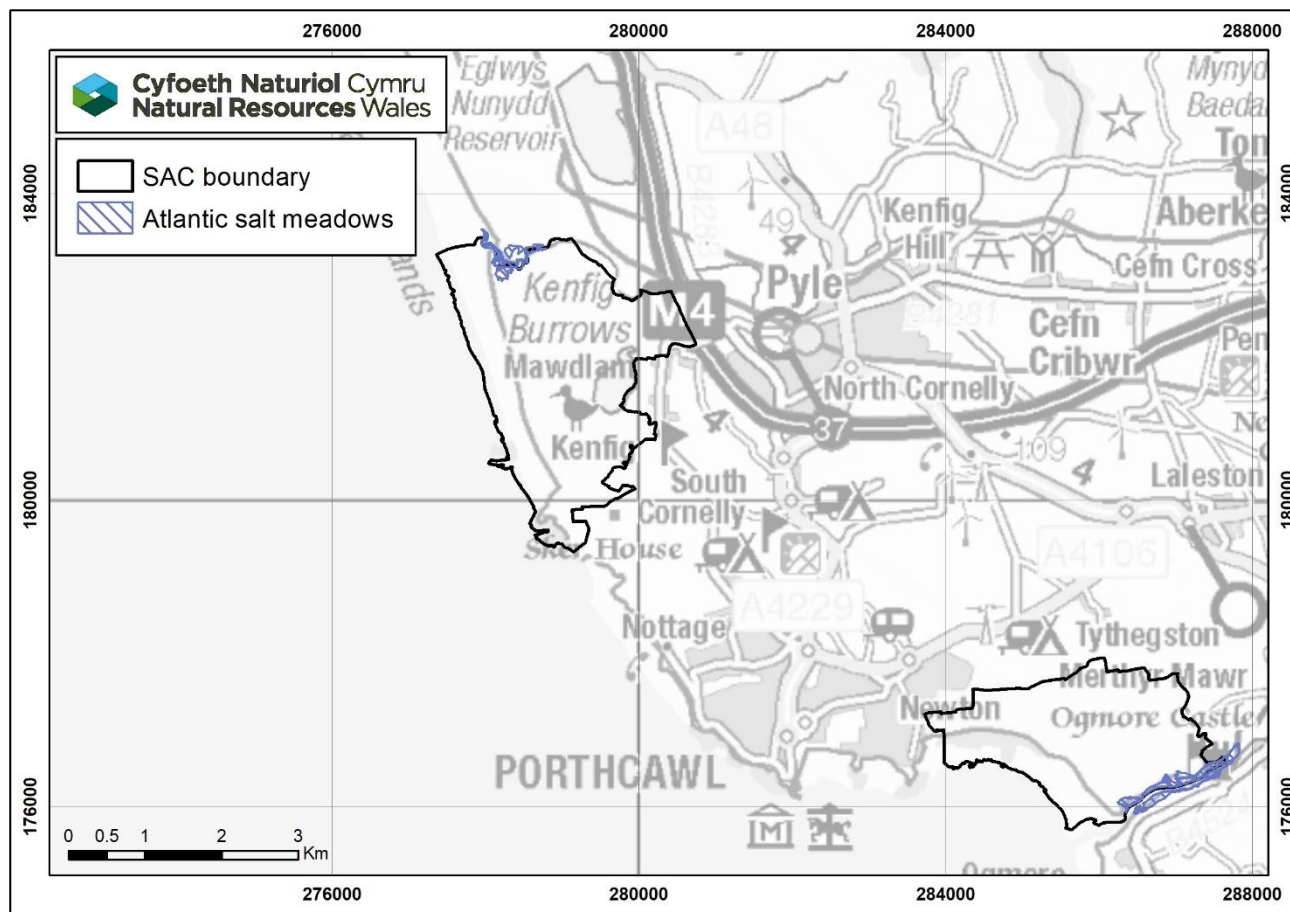**Figure 10.** Map of the ASM feature in Kenfig SAC.

Table 10 has a summary of the assessment outcome against each performance indicator. The outcomes and any reasons for failure are discussed in more detail in the sections below.

Table 10. Condition assessment of the ASM feature in Kenfig SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature extent	The extent of the saltmarsh within the SAC should be stable or increasing, allowing for natural change and variation. (P)	• Between 2000 and 2019-2020, there has been a gain of 1.95 ha (15%) of saltmarsh extent. • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.	**Pass**	Medium
Distribution of feature	Maintain the distribution of saltmarsh throughout the SAC, allowing for natural change and variation. No significant loss from any of the defined sectors. Significant is defined as loss from any sector not to exceed 20%. (P)	• There has been no significant loss of saltmarsh extent in any of the defined sectors. • The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.	**Pass**	Medium
Distribution and extent of habitats and communities	Maintain the distribution and extent of saltmarsh habitats and communities, allowing for natural change. (P)	• An NVC survey of the SAC was carried out in 2020, however this was focused on the sand dune habitat, and only areas of saltmarsh adjacent to the sand dunes were mapped in this survey. The saltmarsh has not been systematically surveyed, however a wide range of saltmarsh vegetation was recorded. • The previous NCV maps (1991) were deemed to be too old to use for an assessment of distribution and extent.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Physical structure: creeks and pans	Maintain the expected patterns of creeks and pans throughout the SAC, allowing for natural change and variation (P). Artificial drainage channels adversely affecting hydrology are absent or rare. (P)	• There are no anthropogenic impacts known to have significantly affected the creeks and pans in the saltmarsh since SAC designation. • There are currently no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. • As the saltmarsh in the SAC is relatively small, any significant impact would likely be noticed, therefore the confidence in the pass is high.	**Pass**	High
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity, allowing for natural variation and change. (T)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of the saltmarsh. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the saltmarsh. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence

Water quality: contaminants	Water column contaminants not to exceed the EQS. (T)	• Both of the WFD waterbodies that overlap with the ASM feature have a fail for chemicals or specific pollutants in the 2024 cycle 3 interim classification (Ogmore Estuary and Swansea Bay).
		
		  o The Ogmore Estuary waterbody fails for zinc and overlaps with 8% of the feature. Some of the chemical classifications were rolled forward from the 2021 cycle 3 classification.
		
		  o The Swansea Bay waterbody fails for mercury, PBDE and PAH, and overlaps with 6% of the feature. Some of the chemical classifications were rolled forward from previous cycles.
		
		• Confidence is medium as the human health standard has been used for PBDE; some waterbodies have rolled forward classifications; and WFD water quality sampling is not focused on saltmarshes.
			Fail	Medium

Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• Both of the overlapping WFD waterbodies were classified with a Moderate status for DIN in the 2024 cycle 3 interim classification (Ogmore Estuary and Swansea Bay). Combined, these waterbodies overlap with 14% of the feature. • Confidence is medium as WFD water quality sampling is not focused on saltmarshes.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• Neither of the two WFD waterbodies that overlap with the feature have been classified for the opportunistic macroalgae WFD element in the 2024 cycle 3 interim classification.	**Unknown**	N/A
Air quality	Nitrogen deposition should not exceed the critical load range of 10-20 kg N per ha^{-1} per year. (S)	• Nitrogen deposition within the SAC (where data were available) was under 10 kg N per ha per year for all saltmarshes and did not exceed the critical load on average (APIS). • Confidence is high as the recorded nitrogen deposition is below the lower range of the critical load.	**Pass**	High
Vegetation structure: sward height	Maintain the expected structural variation within the sward height, allowing for natural change and variation. The majority of plants should be able to produce flowers and set seed. (P)	• Some areas in the north part of Kenfig SAC were under-grazed, but this was not deemed to be enough to fail the indicator. • No information was available for the rest of the feature, resulting in a low confidence.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence of INNS presence within the ASM feature. • Confidence is medium as the spread and impacts of any INNS present within the SAC are not well understood, and there have been no targeted surveys of NNS within the ASM feature.	**Pass**	Medium
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There are no known records of NNS within the ASM feature. • Confidence is medium as there have been no targeted surveys for NNS within the feature.	**Pass**	Medium

Assessment conclusions

The Atlantic salt meadow (ASM) feature in Kenfig SAC has been assessed as being in **favourable** condition (low confidence). Overall, the lack of any significant anthropogenic impact on this feature in terms of extent, topography and physical processes have contributed to this favourable assessment outcome. There were a couple of indicators with failing targets (Table 11). There were also limited or absent data for four key indicators to inform on the condition of the feature (see evidence gaps section 5). This has reduced the confidence in the assessment conclusion. Further investigation is needed to better understand all of the indicator failures to be able to identify management options.

A summary of the assessment can be seen in Table 11 with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 11. Summary of the condition assessment for the ASM feature in Kenfig SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Kenfig	**Favourable (low confidence)**	Water quality: contaminants (T) Water quality: nutrients (DIN only) (T)	• Levels of mercury, PBDE, PAH or zinc in the Ogmore Estuary and Swansea Bay waterbodies are failing to meet their relevant EQSs. • High nutrient levels have been recorded in the Swansea Bay and Ogmore Estuary waterbodies.	• Unconsented infrastructure • Trampling • Water quality: contaminants • Climate change

Detailed assessment information

Extent and distribution

Saltmarsh extent has been mapped using imagery from 2000 and 2019-2020. The total extent of saltmarsh was measured as 14.94 ha in 2019/20 compared to 12.99 ha in 2000, indicating a total gain of 1.95 ha (15%). There has been no loss of saltmarsh extent in any of the defined sectors. In the Ogmore sector there has been a 22.85% gain in saltmarsh extent, and in the Kenfig sector there has been no change. Therefore, both the feature extent and distribution of the feature indicators met their targets. The mapping is based on high quality imagery, however the changes in extent are indicative only, as there has been no ground truthing. Therefore the confidence associated with the pass is medium.

The distribution and extent of habitats and communities, a key indicator to inform on the condition of the feature, was assessed as unknown as the available NVC mapping (Jones, 1991) from the northern boundaries of Kenfig dunes area was deemed to be too old to use in the assessment. An NVC survey of the Kenfig SAC sand dunes was carried out in 2020, however only areas of saltmarsh that were adjacent to the dunes were mapped in this survey. A wide range of saltmarsh vegetation was recorded, however as a systematic survey of the saltmarsh area was not carried out, this could not be used for the assessment.

Physical structure

There are no anthropogenic activities known to have significantly affected the creeks and pans in the saltmarsh since designation and no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. The physical structure (creeks and pans) indicator therefore passed its target. This assessment has been predominantly based on a report produced in 2009. As the saltmarsh within the SAC is relatively small, any significant impact on the saltmarsh would likely be noticed. For these reasons, the confidence in the indicator pass is high. The saltmarsh extent in this SAC is smaller compared to other SACs therefore it is possible to be more confident that there have been minimal impacts.

Hydrodynamic processes and topography

The hydrodynamic and sediment transport processes, and the topography of the feature indicators were assessed as passing their targets as currently there are no known anthropogenic activities that would have significantly altered these aspects. This assessment was based on expert judgement and knowledge of assessments of plans and projects in the SAC which has reduced the confidence in the assessment to medium, as it is difficult to be certain of impacts to the condition of the feature in the absence of data. In future, Lidar data could potentially be used to quantify changes in topography.

Water and air quality

It has been estimated that approximately 14% of the ASM feature within the SAC falls within four WFD waterbodies. The upper marsh areas are above the high-water mark and are therefore outside of the WFD waterbody boundary. However, marine water input to the upper marsh will be from these waterbodies therefore these waterbodies are likely to be a

good reflection of the overall effect of water quality on the feature. However, as the WFD water quality sampling is not focused on saltmarshes, the confidence has been reduced in all of the relevant water quality assessments.

Contaminants

Both of the WFD waterbodies that overlap with the ASM feature had failures for chemicals or specific pollutants, leading to a failure for the contaminants indicator. The Ogmore Estuary waterbody overlaps with 8% of the mapped ASM feature, and failed for zinc. This waterbody has failed for zinc in all previous cycles. The Swansea Bay waterbody overlaps with 6% of the feature, and failed for mercury, PBDE and PAH. There has been a waterbody status change from pass to fail in the Swansea Bay waterbody between the 2021 cycle 3 classification and the 2024 cycle 3 interim classification, however two of the failing contaminants (PBDE and PAH) were not classified in previous cycles. Mercury has failed in this waterbody in all classifications since the 2015 cycle 2 classification except in the 2021 cycle 3 classification. The waterbody status changes for mercury between cycles are likely due to changes in WFD classification methodology. The human health protection goal that is used for PBDE may be considered as over precautionary as the effect of contaminants on the biota of the ASM feature are not fully understood.

In both WFD waterbodies, some of the chemical classifications were rolled forward from previous cycles as they were not assessed in the 2024 cycle 3 interim classification. Overall, confidence in the fail was medium because the human health standard has been used for PBDE, due to rolled forward classification, and because WFD water quality sampling of chemicals is not focused on saltmarshes. In addition, the impact of the failing contaminants on the feature are not fully understood. The target weighting of the indicator is tertiary to reflect this.

Nutrients (DIN only) and opportunistic macroalgae

The nutrients indicator (DIN only) failed to meet its target as both overlapping WFD waterbodies were classified with a Moderate status for DIN in the 2024 cycle 3 interim classification. These are the Ogmore Estuary and Swansea Bay waterbodies, which combined overlap with 14% of the feature. There has been no change in the Moderate status in both WFD waterbodies since previous cycles. The Moderate status for DIN in these waterbodies were confirmed in the 2021 WFD investigation reports, but that there is no evidence of ecological impacts from the elevated DIN in relation to phytoplankton, macroalgae or invertebrates (Newman, 2021; Jones, 2021d). Investigations have confirmed DIN failures in the relevant WFD waterbodies, however as WFD water quality sampling is not focused on saltmarshes, confidence in the fail was reduced to medium. The nutrients indicator (DIN only) was given a tertiary weighting as the effects of high nutrient levels on the ASM feature are not fully understood.

The indicator for opportunistic macroalgae was assessed as unknown. This was because both of the WFD waterbodies were not classified for the opportunistic macroalgae element in the 2024 cycle 3 interim classification, as no data has been collected for this element over the last six years (see Section 3). Some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum (i.e. areas of intertidal habitat for opportunistic macroalgal growth). The 2021 WFD investigations did not find evidence of an ecological impacts from the DIN issues in relation to opportunistic macroalgae, however as these waterbodies have not been physically assessed for this element, this indicator was assessed as unknown.

Air quality

High levels of nitrogen deposition from the atmosphere can have detrimental impact on saltmarsh since they are nitrogen limited. The nitrogen deposition within the SAC, where data were available, was under 10 kg N per ha per year for all saltmarshes and did not exceed the critical load of 20 kg N per ha per year, resulting in this indicator to pass with high confidence.

Species and communities

Plant communities are not currently monitored in Kenfig SAC as there is no specific monitoring resource available to assess the condition of ASM plant communities. WFD Regulations data could potentially be used further in future assessments, however, WFD waterbodies within the SAC are not currently monitored in the WFD saltmarsh assessments. This is a key indicator to inform on the condition of the feature, however as there were no data available the abundance, distribution and species composition of communities indicator could not be assessed.

Vegetation structure

There is evidence that some areas in the northern part of the SAC are under-grazed since it is not under management. This was not considered to be enough of an issue to fail the sward height indicator within the Kenfig SAC. The habitat in the north is comprised of plants that do not necessarily need grazing, so the lack of grazing is not an issue in this part of the SAC. For this reason, the sward height indicator met its target. Trampling along the coastal path has been observed on the Ogmore estuary and could be a concern. There was no information available for the rest of the SAC resulting in low confidence in the pass. The zonation of vegetation indicator has not been assessed as there was no WFD monitoring for this feature.

Invasive non-native species

The saline conditions of saltmarshes prevent the common terrestrial NNS in Wales becoming established. There are no known records of NNS within the ASM feature, resulting in both the primary and tertiary targets for the INNS and NNS indicators to be met.

There are unconfirmed reports of *L. americanus* in the area near the river, but this is not present on the saltmarsh.

Both the primary and tertiary targets for the INNS and NNS indicators passed with a medium confidence as there have been no targeted NNS surveys on saltmarshes, which would be required to fully understand the presence and impacts of any NNS species within the ASM feature.

Reasons for target failure

The ASM feature in Kenfig SAC has been assessed as being in **favourable** condition. However, two tertiary targets failed to be met and need to be kept under review.

Water quality: contaminants

This indicator target has a tertiary weighting. The contaminants indicator failed to meet its target as both of the overlapping WFD waterbodies failed for chemicals or specific pollutants in the 2024 cycle 3 interim classification (Ogmore Estuary and Swansea Bay). In the Ogmore Estuary waterbody, the failure was due to zinc, and in the Swansea Bay waterbody it was due to mercury, PBDE and PAH. Zinc can enter the marine environment from agricultural and land runoff, from its use in pesticides and from abandoned mines and industrial estates (King, 2021; Sonesten et al., 2022). It is also put directly into the marine environment, from the use of corrosion anodes on ship's hulls or marine installations (Larsen and Hjermann, 2022). Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022). Mercury has been used in many industries, but today the primary sources are burning of coal and artisan mining for mercury (Larsen and Hjermann, 2022). PAHs can be produced through natural processes, but also arise from anthropogenic sources, for example during combustion of fossil fuels and organic material (Webster and Fryer, 2022).

The WFD investigation report for the Ogmore Estuary waterbody determined that the likely sources of zinc are point sources from continuous and intermittent sewage discharge, and diffuse sources from abandoned mines and industrial estates in the catchment (King, 2021). A WFD investigation of the failure in the Swansea Bay waterbody is yet to be undertaken. Mercury and PBDE are being managed and it is hoped that these levels will reduce in time. There is currently no management in place for PAH. The PAH EQS is based on the most sensitive taxa and may not be applicable to all of the biota of the ASM feature. The impact of PAH on the condition of the ASM feature is not fully understood.

Water quality: nutrients (DIN only)

This indicator target has a tertiary weighting. The nutrients indicator failed to meet its target as both overlapping WFD waterbodies were classified with a Moderate status for DIN in the 2024 cycle 3 interim classification (Swansea Bay and Ogmore Estuary). The WFD investigation reports have confirmed the DIN failure in both WFD waterbodies (Newman, 2021; Jones, 2021d). Likely sources of elevated nutrients into the Ogmore Estuary waterbody are diffuse sources from agriculture and rural land management, and point sources from intermittent and continuous sewage discharge (Jones, 2021d). A detailed source apportionment exercise for this waterbody is recommended if the waterbody continues to fail for DIN in the future. Source apportionment in the Swansea Bay waterbody has identified that a likely major source of nutrients is continuous and intermittent sewage discharge, with minor diffuse sources from urban and transport sewage discharge and agriculture and rural land management (Newman, 2021).

Threats to condition

Part of the condition assessment is to identify threats to the condition of the ASM feature. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition. The threats to the condition of the ASM feature in Kenfig SAC are stated below.

Unconsented infrastructure

New unconsented infrastructure, such as private slipways and coastal defences, modify the coastal environment through changes to micro-topography and hydrodynamics and can lead to loss of the feature extent, and impacts to the flora and fauna associated with it.

Trampling

Trampling along the coastal path has been observed on the Ogmore estuary and could be a concern if levels increase as it can lead to the reduction of plant diversity, soil erosion and reducing elevation.

Invasive non-native species

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Water quality: contaminants

There is the potential for unregulated contaminants (such as PFAS) to increase. This could affect some of the biota of the ASM feature as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024; Oaten et al., 2024):

- Sea level rise.
- Changes in air temperature.
- Increases in wave exposure.
- Changes in species distribution.

4. Other annuals colonising mud and sand (*Salicornia*) condition assessments

This section contains assessments for the other annuals colonising mud and sand (*Salicornia*) feature in Welsh only ACAs / SACs. The designated *Salicornia* features are found in three SACs in Wales (Figure 11):

- Glannau Môn: Cors heli / Anglesey Coast: Saltmarsh
- Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau
- Bae Caerfyrddin ac Aberoedd / Carmarthen Bay and Estuaries

More information on the SACs and their features can be found in NRW's conservation advice on our website.

The indicators were assessed using a combination of NRW Habitats Regulations monitoring, Water Environment (Water Framework Directive) Regulations 2017 (WFD Regulations) monitoring, commissioned evidence reports, external monitoring databases (e.g. National Biodiversity Network (NBN) Atlas), plan and project assessments and expert judgement. The outcome of the assessment and reasons for failure are discussed in more detail in the sections below.

In these condition assessments, the WFD 2024 cycle 3 interim classification was the default information used for water quality, however other earlier cycles were referenced, as follows:

- 2009 cycle 1 classification
- 2015 cycle 2 classification
- 2018 cycle 2 interim classification
- 2021 cycle 3 classification

In the WFD classification, results are rolled forward from previous assessments where there are no new monitoring data to provide a new classification. It is used to gap fill and provide a more complete classification. A decision was made to limit roll forward to six years which has been applied to the 2024 cycle 3 interim classification.

Additional information on water quality can be found in the IMCA final report.

Figure 11. Location of SACs assessed for the *Salicornia* feature.
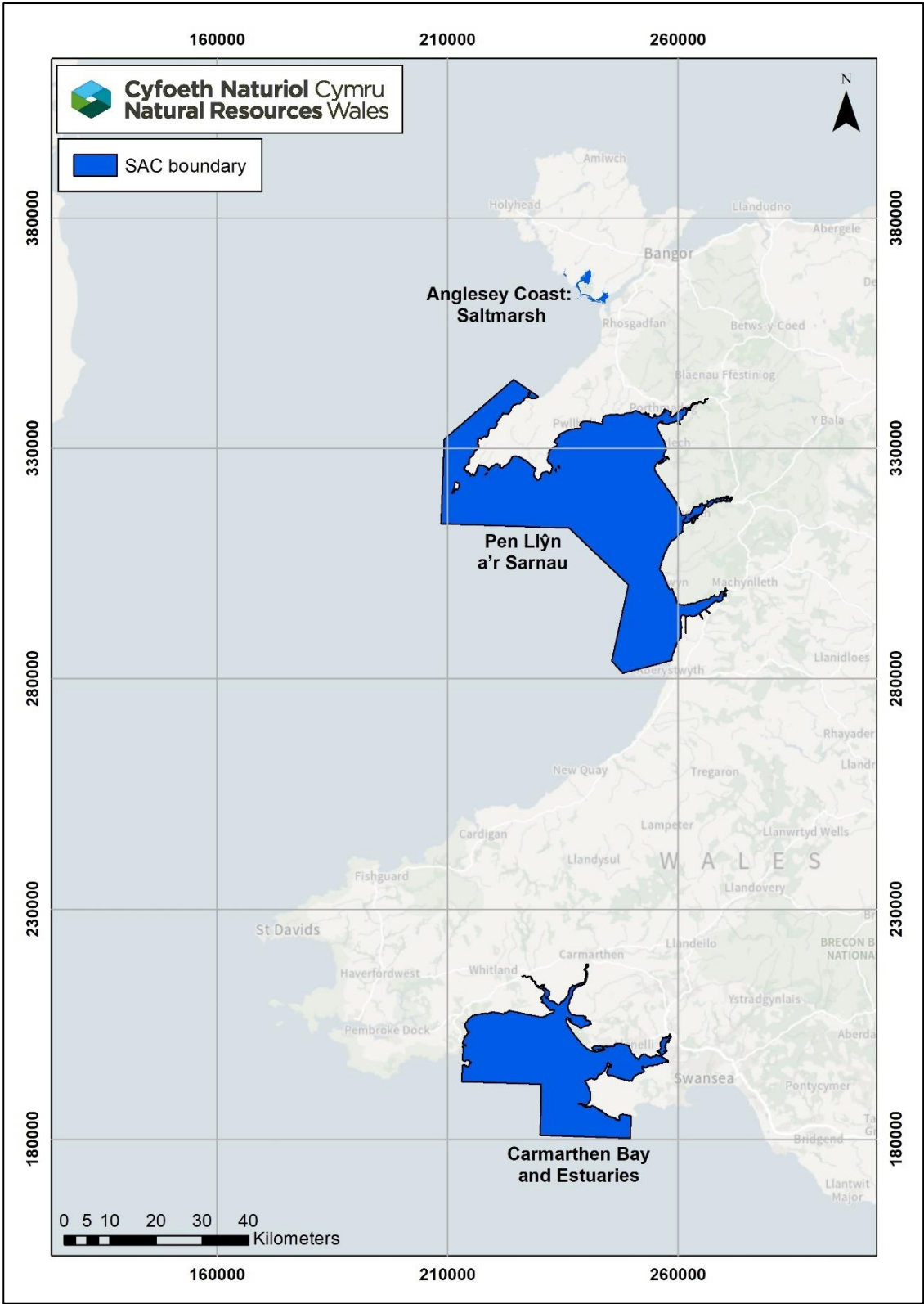
4.1.   Anglesey Coast: Saltmarsh SAC condition assessment

The *Salicornia* feature in Anglesey Coast: Saltmarsh SAC includes *Salicornia* from the Ffraw, Braint and Cefni estuaries (Figure 12). The *Salicornia* feature has been assessed against the performance indicators and an overall condition was assigned for the feature.

Figure 12. Map of the *Salicornia* feature in Anglesey Coast: Saltmarsh SAC.
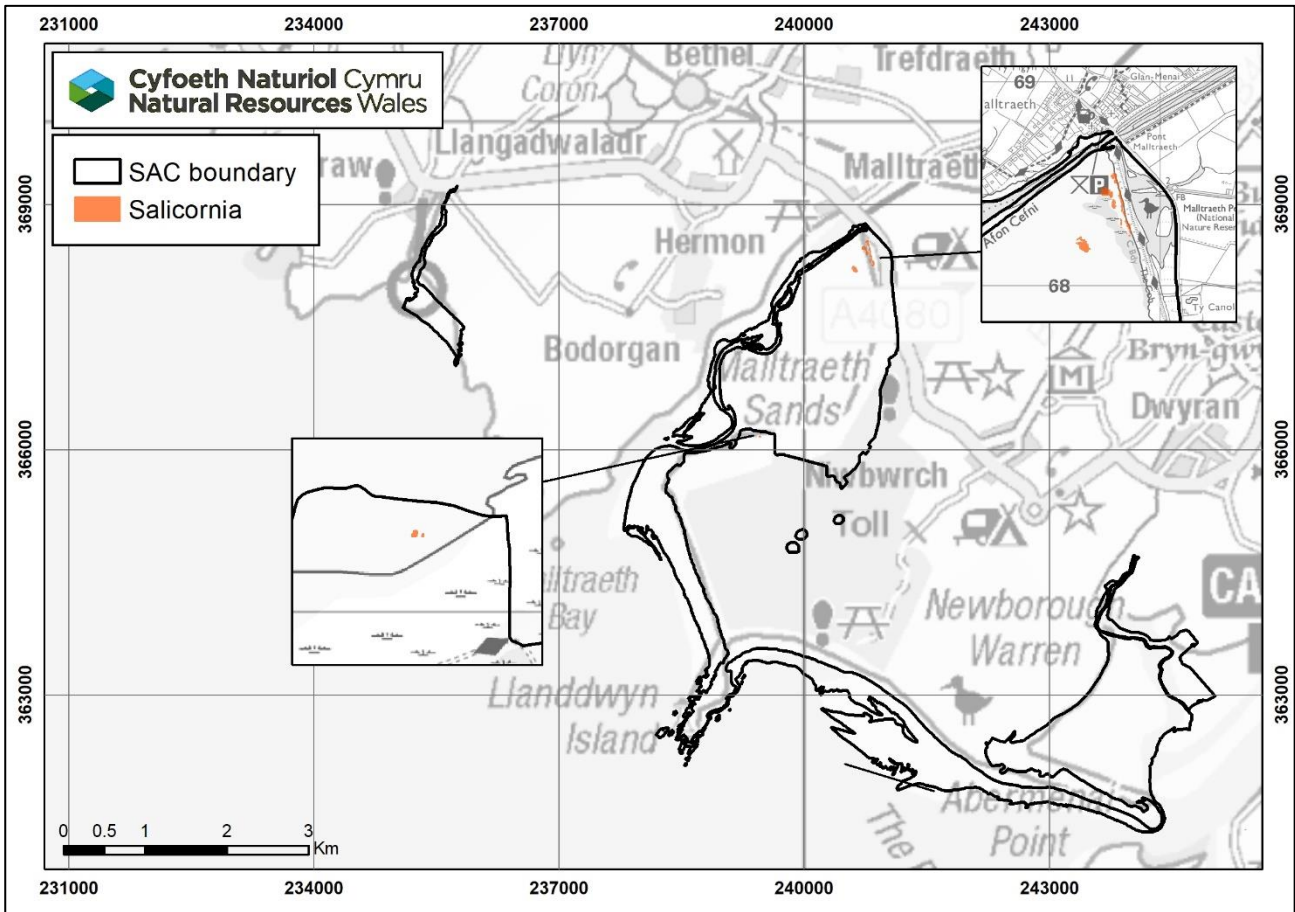

Table 12 has a summary of the assessment outcome against each performance indicator. The outcomes and any reasons for failure are discussed in more detail in the sections below.

Table 12. Condition assessment of the *Salicornia* feature in Anglesey Coast: Saltmarsh SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature extent	The extent of the *Salicornia* within the SAC should be stable or increasing, allowing for natural change and variation. (P)	• The baseline extent of *Salicornia* in Anglesey Coast SAC has been measured as 4.19 ha (1990-2003). • There is no current extent estimate as no up to date mapping of *Salicornia* exists. • There is no evidence to indicate a genuine change in extent of *Salicornia* and the extent of the adjacent ASM feature was maintained. • As there are limited recent data, this indicator was assessed as unknown.	**Unknown**	N/A
Distribution of feature	Maintain the distribution of *Salicornia* throughout the SAC, allowing for natural change and variation. (P)	• *Salicornia* is likely still present in the two defined sectors but due to its pioneer nature the distribution is variable. • There is no evidence to indicate a genuine change in range of *Salicornia*. • As there are limited recent data, this indicator was assessed as unknown.	**Unknown**	N/A
Physical structure: creeks and pans	Maintain the expected patterns of creeks and pans throughout the SAC, allowing for natural change and variation (P). Artificial drainage channels adversely affecting hydrology are absent or rare. (P)	• There are no anthropogenic impacts known to have significantly affected the creeks and pans in the *Salicornia* feature since SAC designation. • There are currently no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. • As the saltmarsh in the SAC is relatively small, any significant impact would likely be noticed, therefore the confidence in the pass is high.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity: allowing for natural variation and change. (T)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of *Salicornia*. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the *Salicornia* feature. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Water quality: contaminants	Water column contaminants not to exceed the EQS. (T)	• Two of the three WFD waterbodies were not classified as the chemicals have not been assessed within the last six years (Cefni and Braint). Combined, these waterbodies overlap with 47% of the feature. • The other WFD waterbody has a pass for chemicals, however all chemical classifications were rolled forward from the 2018 cycle 2 interim classification (Menai Strait). This waterbody overlaps with 32% of the *Salicornia* feature. • Confidence is low due to the unclassified waterbodies and the rolled forward classifications; and as the WFD water quality sampling is not focused on areas within the *Salicornia* feature.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• One of the three overlapping WFD waterbodies was classified with a High status for DIN in the 2024 cycle 3 interim classification (Menai Strait). This waterbody overlaps with 32% of the feature. • One WFD waterbody was classified as Good status (Cefni). However, the confidence of the classification was uncertain. This waterbody was Moderate status for DIN in the 2021 cycle 3 classification. The reported improvement may be due to the different methodologies used for DIN classification. It is not certain if there has been a true improvement in the DIN levels. This waterbody overlaps with 29% of the feature. • The other WFD waterbody was classified with a Poor status (Braint). It overlaps with 18% of the feature. • Confidence is low as there is uncertainty in the Cefni waterbody classification, and as the WFD water quality sampling is not focused on areas within the *Salicornia* feature.	**Fail**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the three overlapping WFD waterbodies was classified with High status for the opportunistic macroalgae WFD element in the 2024 cycle 3 interim classification (Cefni). This waterbody overlaps with 29% of the *Salicornia* feature. • One WFD waterbody was not classified for the opportunistic macroalgae WFD element (Menai Strait). This waterbody overlaps with 32% of the feature. • The other WFD waterbody was classified with a Moderate status (Braint). It overlaps with 18% of the feature. • Confidence is low as the WFD water quality sampling is not focused on areas within the *Salicornia* feature, and because the failing waterbody overlaps with a comparatively small proportion of the feature.	**Fail**	Low
Air quality	Nitrogen deposition should not exceed the critical load range of 20-30 kg N per ha^{-1} per year. (S)	• Nitrogen deposition within the SAC (where data were available) was under 12 kg N per ha per year for all saltmarshes and did not exceed the critical load on average (UK Air Pollution Information System (APIS)). • Confidence is high as the recorded nitrogen deposition is below the lower range of the critical load.	**Pass**	High
Vegetation structure: sward height	Maintain the expected structural variation within the sward height: allowing for natural change and variation. (P)	• There is no evidence of major grazing impact with the saltmarsh therefore the target was met. • Overgrazing is less likely to occur in *Salicornia* as sheep appear to find *Salicornia* unpalatable. • Confidence is high as this feature is in a National Nature Reserve and therefore it is well-maintained.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Vegetation structure: Zonation of vegetation	Maintain the expected range of saltmarsh zonation for the SAC, allowing for natural change and variation. (P)	• The *Salicornia* mapping is out of date and of poor quality and *Salicornia* is difficult to assess using aerial photography. This indicator was therefore assessed as unknown.	**Unknown**	N/A
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence of INNS presence within the *Salicornia* feature. • Confidence is medium as the spread and impacts of any INNS present within the SAC are not well understood, and there have been no targeted surveys of NNS within the *Salicornia* feature.	**Pass**	Medium
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There are no known records of NNS within the *Salicornia* feature. • Confidence is medium as there are no targeted surveys for NNS within the *Salicornia* feature.	**Pass**	Medium

Assessment conclusions

The *Salicornia* feature in Anglesey Coast: Saltmarsh SAC has been assessed as being in **favourable** condition (low confidence). Overall, the absence of any significant anthropogenic impact on the feature has contributed to this favourable assessment outcome. There were two indicators with failing targets (Table 13). There were also limited or absent data for five key indicators to inform on the condition of the feature (see evidence gaps section 5). This has reduced the confidence in the assessment conclusion. Further investigation is needed to better understand all of the indicator failures to be able to identify management options.

A summary of the assessment can be seen in (Table 13) with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 13. Summary of the condition assessment for the *Salicornia* feature in Anglesey Coast: Saltmarsh SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Anglesey Coast: Saltmarsh	**Favourable (low confidence)**	Water quality: opportunistic macroalgae (S) Water quality: nutrients (DIN only) (T)	• There has been opportunistic macroalgae growth in the Braint waterbody. • High nutrient levels have been recorded in the Cefni and Braint waterbodies.	• INNS • Water quality: contaminants • Climate change

Detailed assessment information

Extent and distribution

The baseline extent of *Salicornia* in Anglesey Coast SAC has been measured as 4.19 ha (1990-2003). The current extent of *Salicornia* cannot be calculated as there is no up to date mapping. The extent and distribution of the feature indicators have therefore been assessed as unknown due to a lack of evidence. *Salicornia* is likely still present in the two defined sectors but due to its pioneer nature the distribution is variable. There is no evidence to indicate a genuine change in extent or range of *Salicornia* in Wales since 2013, nor is one considered likely to have occurred. In addition, the extent of the adjacent ASM feature was maintained. However, the lack of data resulted in the distribution and extent of habitats indicator not being assessed. These are key indicators to inform on the condition of the feature and the lack of data has influenced the overall confidence in the assessment.

Physical structure

The assessment of this indicator for the *Salicornia* feature has been based on the outcomes of the ASM feature assessment by proxy. There are no anthropogenic activities known to have significantly affected the creeks and pans in the saltmarsh since designation and no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. The physical structure (creeks and pans) indicator therefore passed its target. The assessment of this indicator was based on expert judgement. There is no evidence of any significant incidents affecting the physical structure in recent years. As the saltmarsh within the SAC is relatively small, any significant impact to the saltmarsh would likely be noticed. For these reasons, the confidence in the indicator pass is high. The *Salicornia* extent in this SAC is smaller compared to other SACs therefore it is possible to be more confident that there are minimal impacts.

Hydrodynamic processes and topography

The hydrodynamic and sediment transport processes, and the topography of the feature indicators were assessed as passing their targets as currently there are no known anthropogenic activities that would have significantly altered these aspects. This assessment was based on expert judgement and knowledge of assessments of plans and projects in the SAC which has reduced the confidence in the assessment to medium, as it is difficult to be certain of impacts in the absence of data. In future, Lidar data could potentially be used to quantify changes in topography.

Water and air quality

It has been estimated that approximately 78% of the *Salicornia* feature within the SAC falls within three WFD waterbodies. As there is no up to date mapping of *Salicornia* this overlap figure may not be completely accurate. Due to this and as the WFD water quality sampling is not focused on areas close to the *Salicornia* feature, the confidence has been reduced in all of the relevant water quality assessments.

Contaminants

The contaminants indicator met the target as one WFD waterbody has a pass for chemicals in the 2024 cycle 3 interim classification. This waterbody, Menai Strait, overlaps with 32% of the *Salicornia* feature. The chemical classifications for this waterbody were rolled forward from the 2018 cycle 2 interim classification. This reduced the confidence in the pass. The confidence was further reduced to low as the other two WFD waterbodies were not classified as the chemicals have not been assessed within the last six years. Combined, these waterbodies overlap with 47% of the feature. The impact of contaminants on the feature are not fully understood. The target weighting of the indicator is tertiary to reflect this.

Nutrients (DIN only) and opportunistic macroalgae

The Cefni waterbody was classified with a Good status for the DIN element in the 2024 cycle 3 interim classification. This is an improvement from the 2021 cycle 3 classification of Moderate status. However, the confidence in the 2024 Good status classification is uncertain (confidence of Good or better classification: 55%, confidence of Moderate or worse classification: 45%). The 2021 and 2024 DIN classifications used different methodologies due to the classification process. There has been an improvement in the DIN values recorded between the classifications, however the confidence of the improvement in class for this waterbody is uncertain. The 2021 WFD investigation report (Jones, 2021a) for this waterbody confirmed the DIN failure in the 2021 cycle 3 classification, but found that there has not been a biological response to the elevated nutrients. This waterbody overlaps with a large proportion of the feature (29%). The Braint waterbody was classified with Poor status in the 2024 cycle 3 interim classification. This waterbody overlaps with 18% of the *Salicornia* feature. The Menai Strait waterbody was classified with a High status for DIN, however the sampling locations were not in close proximity to the *Salicornia* feature in the SAC.

The nutrients indicator (DIN only) failed to meet the target due to the issues with DIN in the Cefni and Braint waterbodies. The confidence was reduced to low as the Cefni waterbody was classified as Good status in the 2024 cycle 3 interim classification but with uncertainty in this classification. In addition, because the WFD water quality sampling is not focused on areas within the *Salicornia* feature. The nutrients indicator (DIN only) was also given a tertiary weighting as the effects of high nutrient levels on the *Salicornia* feature are not fully understood.

The opportunistic macroalgae indicator was assessed as failing due to the Moderate status classification for this biological element in the Braint waterbody in the 2024 cycle 3 interim classification. One WFD waterbody was classified with a High status for the opportunistic macroalgae element in the 2024 cycle 3 interim classification. This waterbody, Cefni, overlaps with 29% of the feature. One WFD waterbody, Menai Strait, was not classified for the element. Some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum (i.e. areas of intertidal habitat for opportunistic macroalgal growth). A low confidence was attributed to this failing indicator as the WFD water quality sampling is not focused on areas within the *Salicornia* feature, and because the failing waterbody overlaps with a comparatively small proportion of the feature.

Air quality

High levels of nitrogen deposition from the atmosphere can have detrimental impact on saltmarsh since they are nitrogen limited. The nitrogen deposition within the SAC, where data were available, was under 12 kg N per ha per year for all saltmarshes and therefore did not exceed the critical load of 20 kg N per ha per year (UK Air Pollution Information System (APIS)), resulting in this indicator passing with high confidence.

Vegetation structure

No major grazing issues were identified within the saltmarsh in the SAC. The confidence for the sward height indicator is high as this feature is in a National Nature Reserve and therefore it is well-maintained. In addition, grazing is less likely to occur within the *Salicornia* areas as sheep appear to find *Salicornia* unpalatable

The zonation of vegetation indicator has been assessed as unknown. *Salicornia* is difficult to assess by aerial imagery as its density can be sparse. True extent measurement is unrealistic with this sampling technique. Further investigation with ground truthing evidence will be needed to adequately assess the extent of *Salicornia* in future.

Invasive non-native species

The saline conditions of saltmarshes prevent the common terrestrial NNS in Wales becoming established. There are no known records of NNS within the *Salicornia* feature in the Anglesey Coast: Saltmarsh SAC, resulting in both the primary and tertiary targets for the INNS and NNS indicators to be met.

There were, however, some notable records of NNS within the SAC. *G. vermiculophylla* has been recorded since 2022 in nearby mudflats and sandflats habitat in the Malltraeth estuary. Whether it is present within the *Salicornia* feature is unclear but there is no evidence to suggest that it could negatively impact *Salicornia*. More research is required to understand whether it would be detrimental to *Salicornia*, where present.

Both INNS and NNS targets passed with a medium confidence as there have been no targeted NNS surveys within *Salicornia*, which would be required to fully understand the presence and impacts of any NNS species within the *Salicornia* feature.

Reasons for target failure

The *Salicornia* feature in Anglesey Coast: Saltmarsh SAC has been assessed as being in **favourable** condition. However, one secondary target and one tertiary target failed to be met and need to be kept under review.

Water quality: opportunistic macroalgae

This indicator target has a secondary weighting. The Braint waterbody was classified with a Moderate status for the opportunistic macroalgae biological element in the 2024 cycle 3 interim classification. There are excessive levels of algae in the intertidal area which suggests that nutrient enrichment is causing elevated growth in these species. The WFD investigation in this waterbody is ongoing.

Water quality: nutrients (DIN only)

This indicator target has a tertiary weighting. One of the WFD waterbodies that overlaps with the feature, the Braint, was classified with a failing status for the DIN element in the 2024 cycle 3 interim classification. The WFD investigation of the failures in this waterbody is ongoing, but has confirmed the failure in the DIN classifications at stage 1 (Borrowdale and Moore, in draft). Stage 2 of the investigations to identify potential reasons for failure have not yet been completed.

The Cefni waterbody, whilst classified as Good in the 2024 cycle 3 interim classification, remained close to the failure threshold. This waterbody was Moderate status in the 2021 cycle 3 classification. Different methodologies were used for the assessment of the DIN in the 2021 and 2024 classification, therefore there is uncertainty that there has been a genuine improvement in class. The 2021 WFD investigation report for the Cefni waterbody confirmed the DIN failure, but found that there has not been a biological response to the elevated nutrients (Jones, 2021a). It was concluded that the major input of nutrients is likely to be derived from diffuse sources associated with agriculture and rural land management, and point sources from the water industry (Jones, 2021a).

Threats to condition

Part of the condition assessment is to identify threats to the condition of the *Salicornia* feature. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition. The threats to the condition of the *Salicornia* feature in Anglesey Coast: Saltmarsh SAC are stated below.

Invasive non-native species

G. vermiculophylla has the capacity to smother *Salicornia* plants, reducing the density of *Salicornia*. At high densities, this red seaweed could block recruitment of *Salicornia* and other angiosperms and turn the sediments anoxic, reducing their capacity to support saltmarsh plants and animals and change the sedimentation regime (increase sedimentation of muds), altering the topography of the sediment flats / saltmarsh. This seaweed has been recorded in nearby mudflat and sandflat habitats. *Salicornia* is likely to be more at risk than the ASM feature. More research is required to understand whether the species would be detrimental to *Salicornia*, and if it is present in areas within the *Salicornia* feature.

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Water quality: contaminants

There is the potential for unregulated contaminants (such as PFAS) to increase.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024; Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent.
- Changes in air temperature.
- Increases in wave exposure.
- Changes in species distribution.

4.2.   Pen Llŷn a`r Sarnau SAC condition assessment

The *Salicornia* feature in Pen Llŷn a`r Sarnau SAC includes *Salicornia* from the Mawddach, Glaslyn and Dwyryd estuaries (Figure 13). The *Salicornia* feature has been assessed against the performance indicators and an overall condition was assigned for the feature.

Figure 13. Map of the *Salicornia* feature in Pen Llŷn a`r Sarnau SAC.
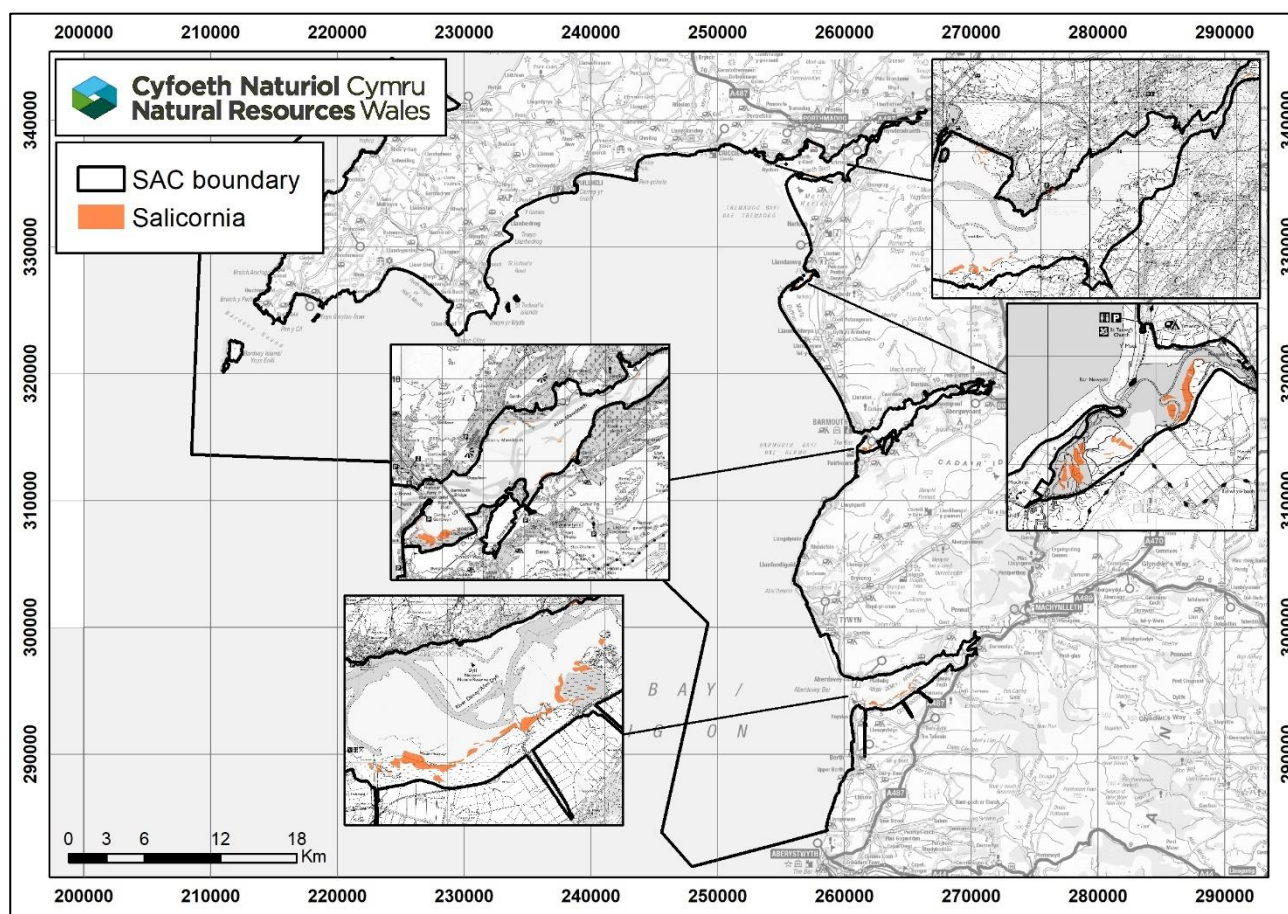

Table 14 has a summary of the assessment outcome against each performance indicator. The outcomes and any reasons for failure are discussed in more detail in the sections below.

Table 14. Condition assessment of the *Salicornia* feature in Pen Llŷn a`r Sarnau SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature extent	The extent of *Salicornia* within the SAC should be stable or increasing, allowing for natural change and variation. (P)	• The baseline extent of *Salicornia* in Pen Llŷn a`r Sarnau SAC has been measured as 84.8 ha (1990-2003). • There is no current extent estimate as no up to date mapping of *Salicornia* exists. • There is no evidence to indicate a genuine change in extent of *Salicornia* and the extent of the adjacent ASM feature was maintained. • As there are limited recent data, this indicator was assessed as unknown.	**Unknown**	N/A
Distribution of feature	Maintain the distribution of *Salicornia* throughout the SAC, allowing for natural change and variation. (P)	• *Salicornia* is likely still present within the component estuaries: Dyfi, Glaslyn, Artro and Mawddach. • There is no evidence to indicate a genuine change in range of *Salicornia.* • As there are limited recent data, this indicator was assessed as unknown.	**Unknown**	N/A
Physical structure: creeks and pans	Maintain the expected patterns of creeks and pans throughout the SAC, allowing for natural change and variation (P). Artificial drainage channels adversely affecting hydrology are absent or rare. (P)	• There are no anthropogenic impacts known to have significantly affected the creeks and pans in the *Salicornia* feature since SAC designation. • There are currently no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity: allowing for natural variation and change. (T)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of *Salicornia*. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the saltmarsh. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Water quality: contaminants	Water column contaminants not to exceed the EQS. (T)	• Two of the four WFD waterbodies were not classified as the chemicals have not been assessed within the last six years (Glaslyn and Artro). Combined, these overlap with 18% of the *Salicornia* feature. • One WFD waterbody has a pass for chemicals in the 2024 cycle 3 interim classification (Dyfi / Leri). However, all chemical classifications were rolled forward from the 2021 cycle 3 classification. This waterbody overlaps with 56% of the feature. • The other WFD waterbody has a fail for chemicals (Mawddach), due to PBDE. It overlaps with 20% of the feature. • Confidence is medium as the human health standard has been used for PBDE, some waterbodies have not been classified; and WFD water quality sampling is not focused on areas within the *Salicornia* feature.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• All four WFD waterbodies were classified as Good or High status for DIN in the 2024 cycle 3 interim classification (Dyfi / Leri, Mawddach, Glaslyn and Artro). Combined, these overlap with 94% of the feature. 　○ Three of these waterbody classifications were rolled forward from previous cycles. • Confidence is medium due to the rolled forward classifications, and as WFD water quality sampling is not focused on areas within the *Salicornia* feature.	**Pass**	Medium
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• One of the four WFD waterbodies was not classified for opportunistic macroalgae in the 2024 cycle 3 interim classification (Glaslyn). This waterbody overlaps with 9% of the feature. • The other three WFD waterbodies were classified with a Good status for opportunistic macroalgae in the 2024 cycle 3 interim classification (Dyfi / Leri, Mawddach and Artro). Combined, these overlap with 85% of the feature. 　○ The Mawddach waterbody classification was rolled forward from the 2021 cycle 3 classification. • Aerial images indicated localised growth of opportunistic macroalgae in the pioneer zone in the Artro waterbody, causing the target to fail. • Confidence is low as it is not known how widespread the issue is, and as there are no recorded issues with the DIN in the Artro waterbody.	**Fail**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Air quality	Nitrogen deposition should not exceed the critical load range of 20-30 kg N per ha^{-1} per year. (S)	• Nitrogen deposition within the SAC (where data were available) was under 10 kg N per ha per year for all saltmarshes and did not exceed the critical load on average (APIS). • Confidence is high as the recorded nitrogen deposition is below the lower range of the critical load.	**Pass**	High
Vegetation structure: sward height	Maintain the expected structural variation within the sward height: allowing for natural change and variation. (P)	• *Salicornia* was present with good structure in areas where relatively heavy grazing was present. • Overgrazing is less likely to occur in *Salicornia* as sheep appear to find the *Salicornia* unpalatable. • Confidence is medium as it is based solely on ad-hoc observation and expert judgement.	**Pass**	Medium
Vegetation structure: Zonation of vegetation	Maintain the expected range of saltmarsh zonation for the SAC, allowing for natural change and variation. (P)	• The *Salicornia* mapping is out of date and of poor quality and *Salicornia* is difficult to assess using aerial photography. This indicator was therefore assessed as unknown.	**Unknown**	N/A
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence of INNS presence within the *Salicornia* feature. • Confidence is medium as the spread and impacts of any INNS present within the SAC are not well understood, and there have been no targeted surveys of NNS within the *Salicornia* feature.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There have been no new NNS recorded within the *Salicornia* feature in the SAC. • Confidence is medium as there are no targeted surveys for NNS within the *Salicornia* feature.	**Pass**	Medium

Assessment conclusions

The *Salicornia* feature in Pen Llŷn a`r Sarnau SAC has been assessed as being in **favourable** condition (low confidence). Overall, the absence of any significant anthropogenic impact on the feature and the presence of *Salicornia* even in heavily grazed areas have contributed to this favourable assessment outcome. There were two indicators with failing targets (Table 15). There were also limited or absent data for five key indicators to inform on the condition of the feature (see evidence gaps section 5). This has reduced the confidence in the assessment conclusion. Further investigation is needed to better understand all of the indicator failures to be able to identify management options.

A summary of the assessment can be seen in (Table 15) with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 15. Summary of the condition assessment for the *Salicornia* feature in Pen Llŷn a`r Sarnau SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Pen Llŷn a`r Sarnau	**Favourable (low confidence)**	Water quality: opportunistic macroalgae (S) Water quality: contaminants (T)	• There is localised growth of opportunistic macroalgae in the pioneer zone of the Artro waterbody. • Levels of PBDE in the Mawddach waterbody are failing to meet its relevant EQS.	• INNS • Water quality: contaminants • Climate change

Detailed assessment information

Extent and distribution

The baseline extent of *Salicornia* in Pen Llŷn a`r Sarnau SAC has been measured as 84.8 ha (1990-2003). The current extent of *Salicornia* cannot be calculated as there is no up to date mapping. The extent and distribution of the feature indicators have therefore been assessed as unknown due to a lack of evidence. *Salicornia* is likely still present within the component estuaries: Dyfi, Glaslyn, Artro and Mawddach. In the Glastreath sector in the Dwyryd estuary, there is potentially significant new pioneer saltmarsh. In the Morfa Harlech sector, the former saltmarsh extent is now sandflat, but it may still be present in the SAC elsewhere. There is no evidence to indicate a genuine change in distribution or range of *Salicornia* in Wales since 2013, nor is one considered likely to have occurred. However, the lack of data resulted in the distribution and extent of habitats indicator not being assessed. These are key indicators to inform on the condition of the feature and the lack of data has influenced the overall confidence in the assessment.

Physical structure

The assessment of this indicator for the *Salicornia* feature has been based on the outcomes of the ASM feature assessment by proxy. There are no anthropogenic activities known to have significantly affected the creeks and pans in the saltmarsh since designation and no known artificial drainage channels that would adversely affect the hydrology within the saltmarsh. The physical structure (creeks and pans) indicator therefore passed its target. The assessment of this indicator was based on expert judgment. Confidence in the indicator pass was reduced to medium as it is difficult to be certain of impacts in this SAC in the absence of data.

Hydrodynamic processes and topography

The hydrodynamic and sediment transport processes, and the topography of the feature indicators were assessed as passing their targets as currently there are no known anthropogenic activities that would have significantly altered these aspects. This assessment was based on expert judgement and knowledge of assessments of plans and projects in the SAC which has reduced the confidence in the assessment to medium, as it is difficult to be certain of impacts in the absence of data. In future, Lidar data could potentially be used to quantify changes in topography.

Water and air quality

It has been estimated that approximately 94% of the *Salicornia* feature within the SAC falls within five WFD waterbodies. There is no up to date mapping of *Salicornia* therefore this overlap figure may not be completely accurate. Due to this and as the water quality sampling is not focused on areas close to the *Salicornia* feature, the confidence has been reduced in all of the relevant water quality assessments.

Contaminants

One of the four WFD waterbodies that overlaps with the *Salicornia* feature has a fail for chemicals in the 2024 cycle 3 interim classification. The failure was in the Mawddach

waterbody, which failed for PBDE. This waterbody overlaps with 20% of the feature, which caused the contaminants indicator to fail. The human health protection goal that is used for PBDE may be considered as over precautionary as the effect of contaminants on *Salicornia* are not fully understood. One WFD waterbody, Dyfi / Leri, has a pass for chemicals in the 2024 cycle 3 interim classification. However, the chemical classifications were rolled forward from the 2021 cycle 3 classification. This waterbody overlaps with 56% of the feature. The other two WFD waterbodies were not classified as the chemicals have not been assessed within the last six years. Combined, these overlap with 18% of the feature. The confidence in the failure was reduced to medium due to this and because the human health standard has been used for PBDE. In addition, the impact of the failing contaminants on the feature are not fully understood. The target weighting of the indicator is tertiary to reflect this.

Nutrients (DIN only) and opportunistic macroalgae

The target for the nutrients (DIN only) indicator was met. A medium confidence was attributed to the pass as WFD water quality sampling is not focused on areas within the *Salicornia* feature, and as some WFD waterbody classifications for DIN were rolled forward from previous cycles. The nutrients indicator (DIN only) was also given a tertiary weighting as the effects of high nutrient levels on the *Salicornia* feature are not fully understood.

Three of the four WFD waterbodies that overlap with the *Salicornia* feature were classified with a Good status for the opportunistic macroalgae element in the 2024 cycle 3 interim classification. However, in the Artro waterbody, aerial image analysis in the pioneer zone indicated evidence of opportunistic macroalgae, resulting in a fail for the nutrients indicator. The confidence in this assessment was low since it is difficult to assess how widespread the issue is, and as there have been no recorded issues with the DIN or opportunistic macroalgae elements in the relevant WFD waterbody classifications.

Air quality

High levels of nitrogen deposition from the atmosphere can have a detrimental impact on saltmarsh since they are nitrogen limited. The nitrogen deposition within the SAC, where data were available, was under 10 kg N per ha per year for all saltmarshes and therefore did not exceed the critical load of 20 kg N per ha per year (APIS), resulting in this indicator passing with high confidence.

Vegetation structure

While overgrazing is happening in the Glaslyn and Mawddach saltmarshes, *Salicornia* appeared to be in high abundance from ground observations. Overgrazing is less likely to occur in the *Salicornia* feature as sheep appear to find *Salicornia* unpalatable. The sward height target was therefore met but the confidence was reduced to medium as it is based solely on ad-hoc observation and expert judgement.

The zonation of vegetation indicator has been assessed as unknown. *Salicornia* is difficult to assess by aerial imagery as its density can be sparse. True extent measurement is unrealistic with this sampling technique. Further investigation with ground truthing evidence will be needed to adequately assess the extent of *Salicornia* in future.

Invasive non-native species

The saline conditions of saltmarshes prevent the common terrestrial NNS in Wales becoming established. There have been no new NNS recorded within the *Salicornia* feature in PLAS SAC, and any NNS present are not considered to have an impact on the condition of the feature, resulting in both the primary and tertiary targets for the INNS and NNS indicators to be met.

There were, however, some notable records of NNS within the SAC. *G. vermiculophylla* was first found in Wales in the Glaslyn / Dwyryd estuary in 2017, and since then it has been recorded in the Mawddach, and Dyfi estuaries (Mercer and Brazier, 2023). These specimens appeared to have been washed into the marsh with the tides and although they continued to grow, they were not necessarily persistent. For this reason, *G. vermiculophylla* has been judged to not be having an impact on the condition of the *Salicornia* feature.

Both INNS and NNS targets passed with a medium confidence as there have been no targeted NNS surveys within *Salicornia*, which would be required to fully understand the presence and impacts of any NNS species within the *Salicornia* feature.

Reasons for target failure

The *Salicornia* feature in Pen Llŷn a`r Sarnau SAC has been assessed as being in **favourable** condition. However, one secondary target and one tertiary target failed to be met and need to be kept under review.

Water quality: opportunistic macroalgae

This indicator target has a secondary weighting. Aerial imagery shows evidence of opportunistic macroalgae in the pioneer zone in the Artro waterbody, causing the indicator to fail. There were no failures for the relevant elements in the overlapping WFD waterbodies in the 2024 cycle 3 interim classification, including in the Artro waterbody, therefore there have not been any WFD investigations into the sources of nutrients. Further investigation is required to assess how widespread the issue is.

Water quality: contaminants

This indicator target has a tertiary weighting. The *Salicornia* feature in the SAC is partly within one WFD waterbody (Mawddach) that has a fail for chemicals due to PBDE. Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022).

The PBDE in the Mawddach waterbody may be derived from diffuse sources from contaminated waterbody sediments from industry, and point sources from continuous sewage discharge from the water industry. The WFD investigation of the failure in this waterbody is yet to be undertaken. PBDE is being managed in the UK and it is hoped that these levels will reduce in time.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the *Salicornia* feature. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition. The threats to the condition of the *Salicornia* feature in Pen Llŷn a`r Sarnau SAC are stated below.

Invasive non-native species

G. vermiculophylla has the capacity to smother *Salicornia* plants, reducing the density of *Salicornia* and can therefore have a detrimental impact on the feature (see further detail in section 4.1).

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Water quality: contaminants

There is the potential for unregulated contaminants (such as PFAS) to increase.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024; Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent.
- Changes in air and sea temperature.
- Increases in wave exposure.
- Changes in species distribution.

4.3. Carmarthen Bay and Estuaries SAC condition assessment

The *Salicornia* feature in Carmarthen Bay and Estuaries SAC includes *Salicornia* from the Burry Inlet, Loughor and the Three Rivers estuaries (Figure 14). The *Salicornia* feature has been assessed against the performance indicators and an overall condition was assigned for the feature.

Figure 14. Map of the *Salicornia* feature in Carmarthen Bay and Estuaries SAC.
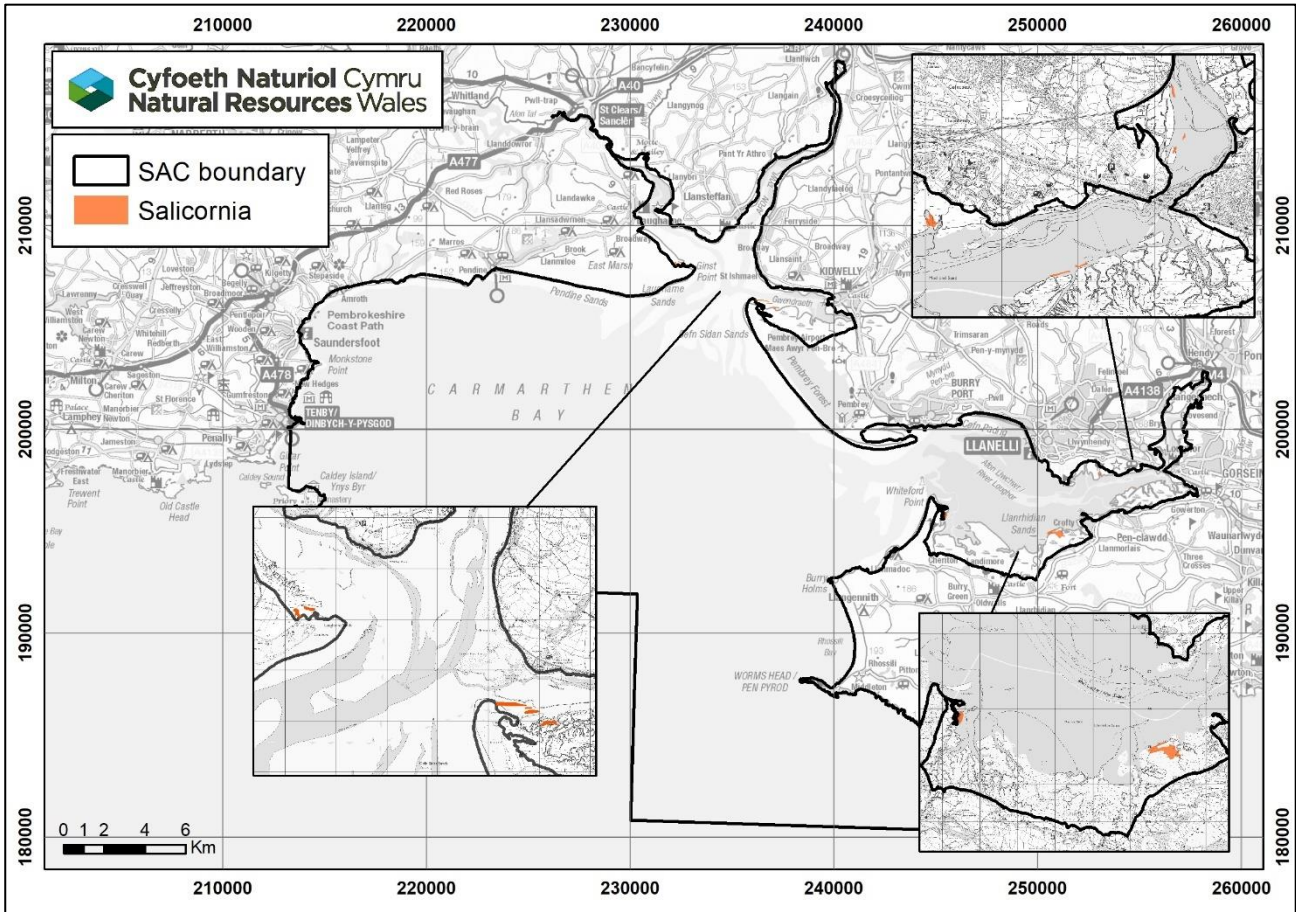

Table 16 has a summary of the assessment outcome against each performance indicator. The outcomes and any reasons for failure are discussed in more detail in the sections below.

Table 16. Condition assessment of the *Salicornia* feature in Carmarthen Bay and Estuaries SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Feature extent	The extent of *Salicornia* within the SAC should be stable or increasing, allowing for natural change and variation. (P)	• The baseline extent of *Salicornia* in Carmarthen Bay and Estuaries SAC has been measured as 34.14 ha (2003). • There is no current extent estimate as no up to date mapping of *Salicornia* exists. • There is no evidence to indicate a genuine change in extent of *Salicornia* and the extent of the adjacent ASM feature was maintained. • As there are limited recent data, this indicator was assessed as unknown.	**Unknown**	N/A
Distribution of feature	Maintain the distribution of *Salicornia* throughout the SAC, allowing for natural change and variation. (P)	• *Salicornia* is likely still present on all of the defined sectors of the feature, but due to its pioneer nature the distribution is variable. • Ther is no evidence to indicate a genuine change in range of *Salicornia.* • As there are limited recent data, this indicator was assessed as unknown.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Physical structure: creeks and pans	Maintain the expected patterns of creeks and pans throughout the SAC, allowing for natural change and variation. (P) Artificial drainage channels adversely affecting hydrology are absent or rare. (P)	• Minor localised creek damage has been historically recorded in some areas within the SAC. These small and localised impacts are not likely to be changing the structure and function of the creeks and pans across the whole feature. • Some of the damage to the creeks and pans includes creek in-filling with rubble for access for cockling or farming, creation of artificial drainage channels, and creek erosion from farming or grazing activity (trampling). The artificial drainage channels are not considered to be adversely affecting the hydrology within the saltmarsh. • Confidence is medium as these issues are small and localised within the large feature area in the SAC, but the full extent of these issues is unknown. In addition, the evidence is from an older survey (2012).	**Pass**	Medium
Hydrodynamic and sediment transport processes	Maintain hydrodynamic and sediment transport processes, including connectivity: allowing for natural variation and change. (T)	• There are currently no anthropogenic impacts known to be significantly affecting the hydrodynamic and sediment transport processes. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium
Topography of the feature	No significant anthropogenic impacts to the small or large scale topography of *Salicornia*. (P)	• There are currently no anthropogenic impacts known to be significantly affecting the topography of the *Salicornia* feature. • Confidence is medium as the assessment has been based on expert judgment.	**Pass**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the EQS. (T)	• All three of the WFD waterbodies that overlap with the feature have a pass for chemicals in the 2024 cycle 3 interim classification (Burry Inlet Outer, Burry Inlet Inner and Three Rivers Estuary). In all WFD waterbodies, some or all of the chemical classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. • Confidence is medium as the human health standard has been used for PBDE, due to the roll forward of some chemical classifications, and as WFD water quality sampling is not focused on *Salicornia* areas.	**Pass**	Medium
Water quality: nutrients (DIN only)	The WFD classification achieved for winter DIN should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (T)	• One of the three overlapping WFD waterbodies was classified with a Good status for DIN in the 2024 cycle 3 interim classification (Burry Inlet Outer). This waterbody overlaps with 19% of the feature. It was classified as Moderate status in the 2021 cycle 3 classification, and has fluctuated between Good and Moderate status in previous cycles. • The other two WFD waterbodies were classified with a Moderate status for DIN (Three Rivers Estuary and Burry Inlet Inner). Combined, these overlap with 27% of the feature. • Confidence is medium as WFD water quality sampling is not focused on areas within the *Salicornia* feature.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: opportunistic macroalgae	The WFD classification achieved for opportunistic macroalgae should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (S)	• None of the three WFD waterbodies that overlap with the feature have been classified for the opportunistic macroalgae WFD element in the 2024 cycle 3 interim classification.	**Unknown**	N/A
Air quality	Nitrogen deposition should not exceed the critical load range of 20-30 kg N per ha^{-1} per year. (S)	• Nitrogen deposition within the SAC (where data were available) was under 17 kg N per ha per year for all saltmarshes and did not exceed the critical load on average (APIS). • Confidence is high as the recorded nitrogen deposition is below the lower range of the critical load.	**Pass**	High
Vegetation structure: sward height	Maintain the expected structural variation within the sward height: allowing for natural change and variation. (P)	• While there is evidence of overgrazing within the saltmarsh in the SAC, overgrazing is less likely to occur in *Salicornia* as sheep appear to find *Salicornia* unpalatable. • Confidence is medium as it is based solely on expert judgement.	**Pass**	Medium
Vegetation structure: Zonation of vegetation	Maintain the expected range of saltmarsh zonation for the SAC, allowing for natural change and variation. (P)	• The *Salicornia* mapping is out of date and of poor quality and *Salicornia* is difficult to assess using aerial photography. This indicator was therefore assessed as unknown.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities should not adversely affect the condition of the feature. (P)	• There is limited evidence of INNS presence within the *Salicornia* feature. • Confidence is medium as the spread and impacts of any INNS present within the SAC are not well understood, and there have been no targeted surveys of NNS within the *Salicornia* feature.	**Pass**	Medium
Non-native species (NNS)	No increase in the number of introduced NNS by human activities. (T)	• There are no known records of NNS within the ASM feature. • Confidence is medium as there are no targeted surveys for NNS in the *Salicornia* feature.	**Pass**	Medium

Assessment conclusions

The *Salicornia* feature in Carmarthen Bay and Estuaries SAC has been assessed as being in **favourable** condition (low confidence). Overall, the absence of any significant anthropogenic impact on the feature and the presence of *Salicornia* even in heavily grazed areas have contributed to this favourable assessment outcome. There was only one indicator with a failing target (Table 17). There were also limited or absent data for key primary indicators to inform on the condition of the feature (see evidence gaps section 5). This has reduced the confidence in the assessment conclusion. Further investigation is needed to better understand all of the indicator failures to be able to identify management options.

A summary of the assessment can be seen in (Table 17) with more detail on each performance indicator, and any reasons for failure, provided in the sections below.

Table 17. Summary of the condition assessment for the *Salicornia* feature in Carmarthen Bay and Estuaries SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Carmarthen Bay and Estuaries	**Favourable (low confidence)**	Water quality: nutrients (DIN only) (T)	• High nutrient levels have been recorded in the Burry Inlet Inner and Three Rivers Estuary waterbodies.	• INNS • Coastal squeeze • Water quality: contaminants • Climate change

Detailed assessment information

Extent and distribution

The baseline extent of *Salicornia* in Carmarthen Bay and Estuaries SAC has been measured as 34.14 ha (2003). The current extent of *Salicornia* cannot be calculated as there is no up to date mapping. The extent and distribution of the feature indicators have therefore been assessed as unknown due to a lack of evidence. *Salicornia* is likely still present in all of the defined sectors of the feature, but due to its pioneer nature the distribution is variable. There is no evidence to indicate a genuine change in distribution or range of *Salicornia* in Wales since 2013, nor is one considered likely to have occurred. However, the lack of data resulted in the distribution and extent of habitats indicator not being assessed. These are key indicators to inform on the condition of the feature and the lack of data has influenced the overall confidence in the assessment.

Physical structure

The assessment of this indicator for the *Salicornia* feature has been based on the outcomes of the ASM feature assessment by proxy. Localised impacts of creek damage have been recorded in various locations within the saltmarsh in the SAC. The evidence of impacts are minor and localised, they are unlikely to be affecting the structure and function of the creeks and pans in the feature as a whole. In addition, the artificial drainage channels are not considered to be adversely affecting the hydrology within the saltmarsh. Therefore this indicator was assessed as passing the target with medium confidence. See assessment conclusions in the [ASM assessment](#) for further information.

Hydrodynamic processes and topography

The hydrodynamic and sediment transport processes, and the topography of the feature indicators were assessed as passing their targets as currently there are no known anthropogenic activities that would have significantly altered these aspects. This assessment was based on expert judgement and knowledge of assessments of plans and projects in the SAC which has reduced the confidence in the assessment to medium, as it is difficult to be certain of impacts in the absence of data. In future, Lidar data could potentially be used to quantify changes in topography.

Water and air quality

It has been estimated that approximately 46% of the *Salicornia* feature within the SAC falls within four WFD waterbodies. There is no up to date mapping of *Salicornia* therefore this overlap figure may not be completely accurate. Due to this and as the WFD water quality sampling is not focused on areas close to the *Salicornia* feature, the confidence has been reduced in all of the relevant water quality assessments.

Contaminants

The contaminants indicator met its target as all three of the WFD waterbodies that overlap with the *Salicornia* feature have a pass for chemicals in the 2024 cycle 3 interim classification. However, in all three WFD waterbodies, some or all of the chemical classifications were rolled forward from previous cycles as they were not assessed in the

2024 cycle 3 interim classification. The confidence in the fail was reduced to medium due to this, and as WFD water quality sampling is not focused on areas within the *Salicornia* feature. The impact of contaminants on the feature are not fully understood. The target weighting of the indicator is tertiary to reflect this.

Nutrients (DIN only) and opportunistic macroalgae

The nutrients indicator (DIN only) failed to meet the target as high levels of DIN have been recorded in two of the three WFD waterbodies that overlap with the *Salicornia* feature. These are the Burry Inlet Inner and Three Rivers Estuary waterbodies, which combined overlap with 27% of the feature. The Moderate status for DIN in these waterbodies were confirmed in the 2021 WFD investigation reports (Jones 2021b; Jopson and Newman 2021). There is also a biological response to high nutrient levels in the Burry Inlet Inner waterbody, where phytoplankton was classified with a Moderate status. The other overlapping WFD waterbody, Burry Inlet Outer, was classified with a Good status for DIN in the 2024 cycle 3 interim classification. This waterbody overlaps with 19% of the *Salicornia* feature. This is an improvement from the 2021 cycle 3 classification of Moderate status. See further detail in section 3.4. Confidence in the fail was reduced to medium as WFD water quality sampling is not focused on areas within the *Salicornia* feature, and due to the improvement in DIN in the Burry Inlet Outer waterbody. The nutrients indicator (DIN only) was given a tertiary weighting as the effects of high nutrient levels on the *Salicornia* feature are not fully understood.

The indicator for opportunistic macroalgae was assessed as unknown. This was because none of the three WFD waterbodies were classified for the opportunistic macroalgae element in the 2024 cycle 3 interim classification, as no data has been collected for this element over the last six years (see Section 3). Some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum (i.e. areas of intertidal habitat for opportunistic macroalgal growth).

Sheep grazing and the subsequent wash-off of faecal material from the intertidal saltmarsh on the Burry Inlet is believed to be responsible for episodic events of high bacteria concentrations. There was a pollution event in July and August in 2024 at Llangennith, in which there were spikes in *E. coli* (NRW). This was associated with high numbers of grazing sheep at the time.

Air quality

High levels of nitrogen deposition from the atmosphere can have detrimental impact on saltmarsh since they are nitrogen limited. The nitrogen deposition within the SAC, where data were available, was under 17 kg N per ha per year for all saltmarshes and did not exceed the critical load of 20 kg N per ha per year (APIS), resulting in this indicator to pass with high confidence.

Vegetation structure

While overgrazing is happening across the feature, it is less likely to occur within the *Salicornia* areas as sheep appear to find *Salicornia* unpalatable. The sward height target was therefore met but the confidence was reduced to medium as it is based solely on expert judgement.

The zonation of vegetation indicator has been assessed as unknown. *Salicornia* is difficult to assess by aerial imagery as its density can be sparse. True extent measurement is unrealistic with this sampling technique. Further investigation with ground truthing evidence will be needed to adequately assess the extent of *Salicornia* in future.

Invasive non-native species

The saline conditions of saltmarshes prevent the common terrestrial NNS in Wales becoming established. There are no known records of NNS within the *Salicornia* feature in Carmarthen Bay and Estuaries SAC, resulting in both the primary and tertiary targets for the INNS and NNS indicators to be met.

There were, however, some notable records of NNS within the SAC. *G. vermiculophylla* has been recorded in 2021 and 2022 in nearby mudflats and sandflats habitat within the Burry Inlet. None were seen in the saltmarsh. For this reason, *G. vermiculophylla* has been judged to not be having an impact on the condition of the *Salicornia* feature, but with no evidence of whether it would be detrimental, where present.

Both INNS and NNS targets passed with a medium confidence as there have been no targeted NNS surveys within *Salicornia*, which would be required to fully understand the presence and impacts of any NNS species within the *Salicornia* feature.

Reasons for target failure

The *Salicornia* feature in Carmarthen Bay and Estuaries SAC has been assessed as being in **favourable** condition. However, one tertiary target failed to be met and needs to be kept under review.

Water quality: nutrients (DIN only)

This indicator target has a tertiary weighting. High levels of DIN have been recorded in two of the WFD waterbodies that overlap with the *Salicornia* feature (Burry Inlet Inner and Three Rivers Estuary). The WFD investigation reports have confirmed elevated nutrients in these waterbodies, where it was concluded that major input of nutrients is likely to be derived from diffuse sources associated with farm infrastructure and probable losses from agricultural land for the Burry Inlet Inner waterbody (Jones 2021b; Jopson and Newman 2021). Point source continuous sewage discharge from the water industry were also confirmed as a source of nutrients linked to the DIN failures for both WFD waterbodies (Jones 2021b; Jopson and Newman 2021). Intermittent and domestic sewage are also suspected in the catchments. Further investigation locally is required to confirm these.

Sheep grazing and the subsequent wash-off of faecal material from the intertidal saltmarsh on the Burry Inlet is believed to be responsible for episodic events of high bacteria concentrations.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the *Salicornia* feature. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are

unmanaged. It is important to identify these threats to be able to put pre-emptive management in place to prevent declines in condition. The threats to the condition of the *Salicornia* feature in Carmarthen Bay and Estuaries SAC are stated below.

Invasive non-native species

G. vermiculophylla has the capacity to smother *Salicornia* plants, reducing the density of *Salicornia* and can therefore have a detrimental impact on the feature (see further detail in section 4.1).

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Coastal squeeze

The presence of hard structures for coastal flood defence and erosion control can prevent the natural landward migration of the saltmarsh, resulting in saltmarsh being squeezed between advancing sea levels and extant hard infrastructure.

Water quality: contaminants

There is the potential for unregulated contaminants (such as PFAS) to increase.

Some persistent chemicals are not measured in every WFD waterbody, and some of the relevant WFD waterbodies have not been classified for any chemicals.

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counter act each other. However, threats from climate change may include (Gihwala et al., 2024, Oaten et al., 2024):

- Sea level rise, leading to coastal squeeze and loss of extent.
- Changes in air temperature.
- Increases in wave exposure.
- Changes in species distribution.

5. Evidence gaps for the ASM and *Salicornia* features

There are gaps in the current evidence that NRW feel are needed to be filled to fully understand condition in this feature.

Listed below are current indicators that were either assessed as unknown, not assessed, or assessed with a lower confidence. This was due to either limited data availability, outdated data, or a lack of information. Some indicators are not currently monitored but should be ideally considered in future condition assessments. Not all evidence gaps apply to every SAC, see Table 18 for details.

Table 18. Evidence gaps for the ASM and *Salicornia* features in Welsh SACs. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Assessed status	Comments
Feature extent (P); distribution of feature (P); vegetation structure: zonation of vegetation (P)	Unknown	• The *Salicornia* mapping is out of date and of poor quality in all SACs. *Salicornia* is difficult to assess using aerial photography. More detailed mapping, possibly using drones, in combination with ground truthing is required.
Distribution and extent of habitats and communities (P)	Unknown / not assessed	• There are no recent NVC surveys or monitoring aimed at assessing this target for ASM at any of the SACs. Additional fieldwork would be required to assess this indicator. • There is a lack of information on the distribution and extent of habitats and communities for *Salicornia* in all SACs. More detailed mapping, possibly using drones, in combination with ground truthing is required.
Topography of the feature (P)	Medium confidence (proxy data used)	• The topography of the ASM and *Salicornia* features is not well monitored in any of the SACs. Repeat Lidar surveys taken at mean low water springs for all saltmarshes within the SAC are required.

Indicator	Assessed status	Comments
Abundance, distribution and species composition of communities (P)	Not assessed / unknown / low confidence	• Plant communities are not currently monitored in all of the SACs. Therefore there is a lack of information on the abundance and distribution of plant communities of the ASM and *Salicornia* features. • WFD Regulations data could potentially be used further in future assessments, however, additional analysis will be required. The ASM in the Kenfig SAC is not currently monitored in WFD surveys.
Attributes of local distinctiveness (P)	Not assessed	• There is a lack of information on the named distinctive elements of the ASM feature. Additional fieldwork would be required to assess this indicator in all SACs. For further information on what is locally distinctive see relevant Regulation 37 advice packages.
Vegetation structure: sward height (P)	Low confidence	• Further monitoring surveys are required in the Kenfig SAC as there is currently no information available on sward height of the ASM in the southern part of the SAC.
Vegetation structure: zonation of vegetation (P)	Not assessed	• The zonation of the ASM feature is not currently monitored in the Kenfig SAC.
Water quality: opportunistic macroalgae (S)	Unknown	• This indicator was assessed as unknown in the Carmarthen Bay and Estuaries and Kenfig SACs due to some or all of the overlapping WFD waterbodies not being classified for the opportunistic macroalgae WFD element in the 2024 cycle 3 interim classification. Some WFD waterbodies are not assessed for opportunistic macroalgae as they do not have suitable substratum. • While a localised issue has been identified within the *Salicornia* feature from aerial photos for the Artro in the Pen Llŷn a`r Sarnau SAC, further data are required to determine how widespread and persistent the issue is.
Sediment quality: contaminants (T)	Not assessed	• Currently, there is no sediment monitoring within the ASM and *Salicornia* features in all SACs.

Indicator	Assessed status	Comments
Hydrodynamic and sediment transport processes (T)	Medium confidence (proxy data used)	• The hydrodynamic regime of the ASM and *Salicornia* features is not currently monitored in all SACs.

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