Cyfoeth Naturiol Cymru
Natural Resources Wales

Ardal Cadwraeth Arbennig Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay Special Area of Conservation

Advice provided by Natural Resources Wales in fulfilment of Regulation 37(3) of the Conservation of Habitats and Species Regulations 2017.

June 2025

Garth Pier in the Menai Straits © NRW.

Contents

List of Figures

List of Tables

Crynodeb Gweithredol

Mae'r ddogfen hon yn cynnwys cyngor Cyfoeth Naturiol Cymru ar gyfer ardal cadwraeth arbennig (ACA) Y Fenai a Bae Conwy a gyhoeddwyd o dan Reoliad 37(3) o Reoliadau Cadwraeth 2017. Sef amcanion cadwraeth a chyngor ar weithrediadau.

Mae Adran 1 yn cyflwyno'r safle, pwrpas y cyngor a strwythur yr amcanion cadwraeth. Mae Adran 2 yn cynnwys esboniad o'r rolau a'r cyfrifoldebau, ac mae Adran 3 yn amlinellu amcanion cadwraeth pob nodwedd a gwybodaeth ategol. Mae cyngor ar weithrediadau mewn perthynas â'r safle hwn i'w gael yn Adran 4. Mae rhagor o wybodaeth am yr ACA wedi'i chynnwys yn Atodiad 1.

Isod mae rhestr o nodweddion dynodedig yr ACA hon a dolen uniongyrchol i'r amcanion cadwraeth, ond mae'n bwysig darllen pob adran yn llawn.

Tabl 1. Crynodeb o nodweddion yr ACA a'r ddolen i'r amcanion cadwraeth.

Enw'r ACA	Modweddion Dynodedig	Cysylltiad â'r Amcanlon cadwraeth
Y Fenai a Bae Conwy	• Gwastadeddau llaid neu dywod nas gorchuddir gan y môr ar lanw isel • Riffiau • Ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser • Cilfachau a baeau mawr bas • ogofâu môr dan ddŵr neu'n rhannol dan ddŵr	Amcanion cadwraeth

Executive Summary

This document contains NRW's advice for Menai Strait and Conwy Bay Special Area of Conservation (SAC) issued under Regulation 37(3) of the Conservation Regulations 2017.

Section 1 introduces the site, the purpose of the advice and the structure of the conservation objectives. Section 2 includes an explanation of the roles and responsibilities before Section 3 outlines each feature's conservation objectives and supporting information. Advice on operations in relation to this site is found in Section 4 and information on climate change and coastal squeeze in section 5. Further information on the site is captured in Appendix 1.

Table 1 lists the designated features of this site and provides a direct link to the Conservation Objectives, but it is important that all sections are read in full.

Table 1. Summary of SAC features and link to Conservation Objectives

SAC Name	Designated Features	Link to Conservation Objectives
Menai Strait and Conwy Bay	• Mudflats and sandflats not covered by seawater at low tide • Reefs • Sandbanks which are slightly covered by seawater all the time • Large shallow inlets and bays • Submerged or partially submerged sea caves	Conservation objectives

1. Introduction

The ardal cadwraeth arbennig Y Fenai a Bae Conwy / Menai Strait and Conwy Bay special area of conservation (SAC) is in north west Wales. The site covers the whole of the Menai Strait and extends from Menai Point in the west to the Little Orme/ Rhiwledyn in the east and Traeth Lligwy on Anglesey in the north. The SAC covers approximately 26,483 hectares. It forms part of the UK's National Site Network.

The site was designated in 2004 under Article 4.2 of the Conservation of Natural Habitats and of Wild Fauna and Flora Directive (92/42/EEC) for five habitat features under Annex I. It is one of the best areas in the UK for the following features:

- Mudflats and sandflats not covered by seawater at low tide (abbreviated to mudflats and sandflats)
- Reefs
- Sandbanks which are slightly covered by seawater all the time (abbreviated to sandbanks)

And supports a significant presence of:

- Large shallow inlets and bays (abbreviated to LSIB)
- Submerged or partially submerged sea caves (abbreviated to sea caves)

Feature maps are indicative and represent the best available evidence at the time of publication. No single habitat feature occupies the entire SAC and features overlap in some locations. The extent of most habitat features is not known precisely because accurate mapping is very difficult, expensive and resource intensive. This is further complicated due to the dynamic and mobile nature of some habitats. Work is ongoing to improve our knowledge of where designated habitat features occur in our SACs and maps are updated periodically. When new areas of Annex I habitat are discovered within the boundary of a SAC they automatically become part of the SAC feature where it is already a designated feature of the site.

Three special protection areas (SPAs) overlap the Menai Strait and Conwy Bay SAC: Traeth Lafan, Ynys Seiriol/ Puffin Island and Bae Lerpwl/ Liverpool Bay. A list of overlapping protected sites can be seen in Appendix 2 and the conservation objectives for these protected sites can be found on the NRW website. The boundaries and geographical extents of these sites can be seen on the Joint Nature Conservation Committee (JNCC)) MPA mapper. Several habitats and species within the SAC are also listed in Section 7 of the Environment Act (Wales) which lists habitats and species of principal importance in Wales. There are also OSPAR threatened and declining species and habitats within the SAC. For these additional conservation interests see Appendix 2.

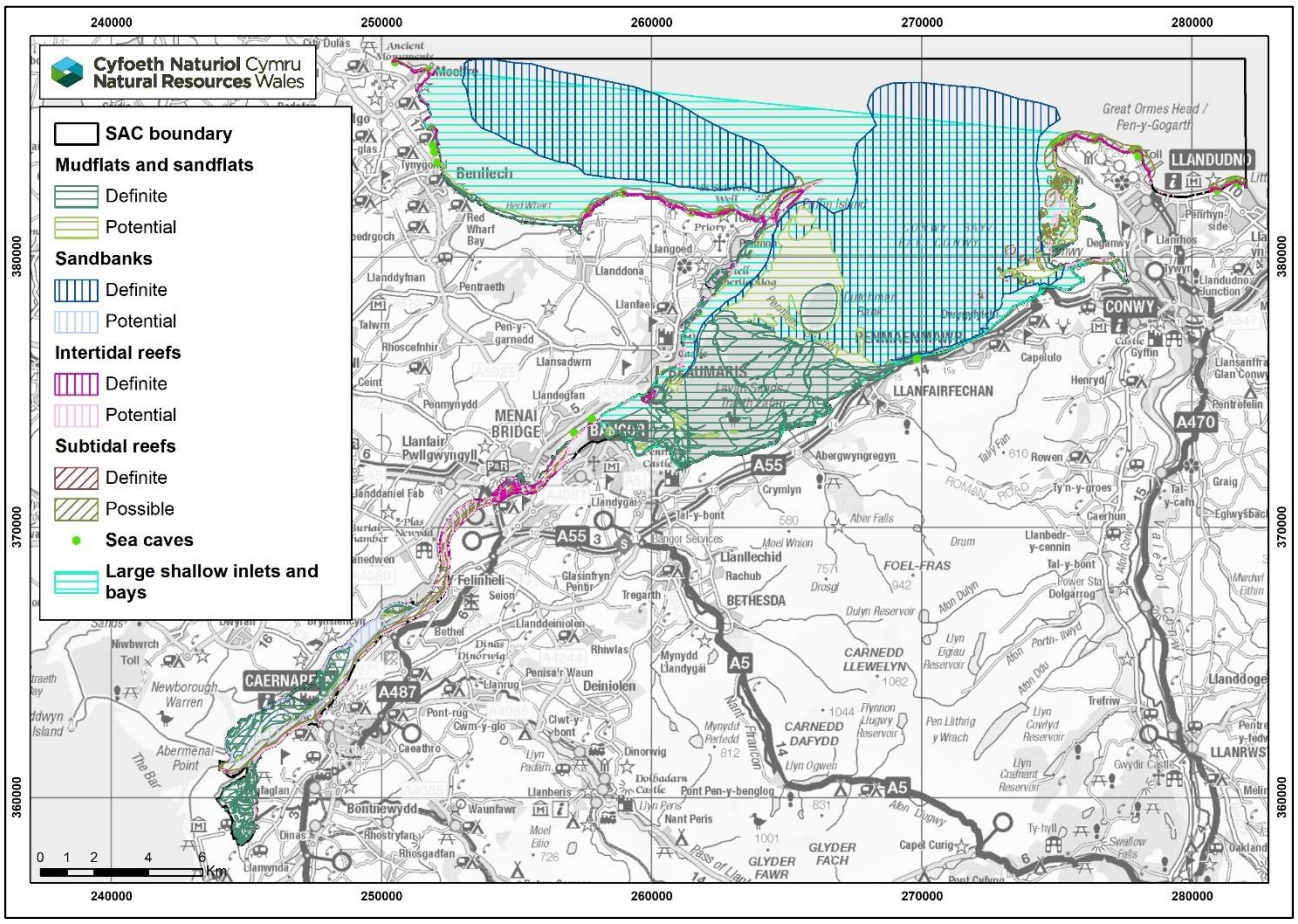
1.1. SAC feature map

The feature locations in maps are indicative and represent the best available evidence at the time of publication. No single habitat feature occupies the entire SAC and features overlap in some locations (See Figure 1). The extent of most habitat features is not known precisely because accurate mapping is very difficult, expensive and resource intensive.

This is further complicated due to the dynamic and mobile nature of some habitats. Work is ongoing to improve our knowledge of where designated habitat features occur in our SACs and maps are updated periodically. When new areas of Annex I habitat are discovered within the boundary of a SAC they automatically become part of the SAC feature where it is already a designated feature of the site.

A map of each habitat feature within the SAC is shown before its conservation objectives. All maps in this document are for illustrative purposes only. Detailed maps for the features in Wales can be found on Data Map Wales.

Figure 1. Map showing the site boundary and designated habitat features of Menai Strait and Conwy Bay SAC.



1.2. The purpose of conservation advice

Conservation advice provides a framework for assessing developments and activities with the potential to affect the features for which a European marine site (EMS) is designated. An EMS is a SAC or SPA which consists of marine areas. Conservation advice presents site specific information, in addition to highlighting activities that are potentially capable of having an impact on the site and its designated species (known as a feature).

This SAC is an EMS subject to protection under the Conservation of Habitats and Species Regulations 2017, as amended (referred to in this document as the 'Habitats

Regulations'). Under the Habitats Regulations, relevant and competent authorities with functions in relation to an EMS must exercise those functions to comply with the requirements of the 1992 European Commission (EC) Habitats and Species Directive and the 2009 EC Wild Birds Directive. The key requirements of these Directives include the conservation of the features (habitat types or species) for which SACs or SPAs are designated. This requires taking appropriate steps to avoid deterioration or disturbance of SAC or SPA features and carrying out appropriate assessment of any plan or project likely to have a significant effect on a SAC or SPA.

This document contains the conservation advice for the Menai Strait and Conwy Bay SAC. It is prepared by Natural Resources Wales (NRW) and given under our duty in Regulation 37(3) of the Habitats Regulations (see Section 2.1).

This advice is based on the best available evidence and information at the time of writing. In some cases, evidence can be limited. It will be kept under review by NRW and updated as and when appropriate.

1.3. Conservation objective structure

The conservation objectives for the designated features in this site are underpinned by conservation objective attributes. These attributes describe the ecological characteristics (e.g. population), and the ecological requirements that allow the conservation objectives for each feature to be met.

Conservation objective attributes have a target which is either quantified or qualified depending on the available evidence. The target identifies, as far as possible, the desired state to be achieved for the attribute. In many cases, the attribute targets show if the current objective is to either 'maintain' or 'restore' the attribute and are based on the latest condition assessment for the feature. Some aspects of feature condition may be assessed as unknown. In these cases, a maintain target will be set as necessary. For attributes that have been assigned 'unknown' in the condition assessment, further information on feature condition and/or activities impacting the feature will be required to inform further advice. Each attribute target will need to be assessed on a case-by-case basis using the most current information available and all are subject to natural change.

The conservation objective attributes that underpin the conservation objectives are used to measure if the objective is being met. This in turn can be used to see if site integrity is being maintained. Failure to meet any attribute means that the conservation objective is not being met and thus site integrity is not being maintained. Below is an example of a conservation objective and associated conservation objective attributes and targets.

Example Objective 1: The overall distribution and extent of the mudflats and sandflats feature within the SAC and each of its main component habitats are stable or increasing, subject to natural change.

Example Objective attribute	**Example Site specific target**
Feature extent and distribution	Maintain/restore the extent and distribution of mudflats and sandflats
Component habitat extent and distribution	Maintain/restore the extent and distribution of mudflat and sandflat component habitats.

The conservation objectives for Menai Strait and Conwy Bay are set out in Section 3. As noted in Section 1.2, NRW may refine these in the future as further information becomes available and increases our understanding of the feature.

The feature's conservation objective section provides:

1. A clear statement of each conservation objective for the feature.

2. A table summarising the attributes, and the targets for those attributes.

3. Supporting information that underpins the selection of the attributes and targets.

2. Roles and responsibilities

2.1. NRW's role

Under Regulation 5 of the Habitats Regulations, NRW is a Nature Conservation Body and, in relation to Wales, is the Appropriate Nature Conservation Body (ANCB).

In its role as the ANCB, NRW has a duty under Regulation 37(3) of the Habitats Regulations to advise relevant authorities in respect of a EMS as to:

(a) the conservation objectives for that site

(b) any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which that site has been designated (see Section 1.2).

Advice on operations which may cause deterioration, together with the conservation objectives, is designed to assist relevant authorities and other decision-makers in complying with their statutory duties under the Habitats Regulations. The advice on operations which may cause deterioration given in this document is without prejudice to other advice given. This includes the conservation objectives themselves, and other advice which may be given by NRW from time to time in relation to any specific operations.

"Operations" is taken to cover all types of anthropogenic activity, irrespective of whether they are under any form of regulation or management. Thus, the advice contains reference to operations which may not be the responsibility of any of the relevant authorities.

NRW will provide additional advice for the site to relevant authorities and competent authorities to allow them to fulfil their duties under the Habitats Regulations. For example, by providing advice to a competent authority assessing the implications of plans or projects on the features of the EMS. Each plan or project will be judged on its own merits, and this will determine the nature of any additional advice required.

2.2. The role of competent and relevant authorities

The expressions used in this advice of "relevant authority" and "competent authority" are as defined in Regulation 3 of the Habitats Regulations. Relevant authorities are specified in Regulation 6 of the Habitats Regulations. Competent Authorities are specified in Regulation 7 of the Habitats Regulations.

Under Part 6 of the Habitats Regulations, all competent authorities must undertake a formal assessment of the implications that any new plans or projects may have on the designated features of a protected site. The implications must be assessed in the context of other plans and projects affecting the same site. Activities outside the site may also affect the features of the site, therefore, plans and projects located outside of a designated site may still need to be assessed.

In respect of the assessment provisions in Part 6 (assessment of plans or projects) of the Habitats Regulations, NRW is also the ANCB in relation to Wales.

The assessment provisions comprise several distinct stages which are collectively described as a Habitats Regulations Assessment (HRA), for which guidance is available. Before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and is not directly connected with or necessary to the management of that site, the competent authority must make an appropriate assessment of the implications of the plan or project for that site in view of that site's conservation objectives.

In light of the conclusions of the HRA and subject to derogation under Regulation 64, the competent authority may agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the EMS. In considering whether a plan or project will adversely affect the integrity of the site, the competent authority must have regard to the manner in which it is proposed to be carried out or to any conditions or restrictions subject to which it proposes that the consent, permission or other authorisation should be given.

Carrying out the HRA process is the responsibility of the decision maker as the competent authority. However, it is the responsibility of the applicant to provide the competent authority with the information that they require for this purpose.

The competent authority has a duty to consult the ANCB for the purposes of the assessment. Under Regulation 63(3) of the Habitats Regulations the competent authority must have regard to any representations made by the ANCB when reaching its decision.

Under Regulation 38(1) of the Habitats Regulations it states that, "*the relevant authorities, or any of them, may establish for a European marine site a management scheme under which their functions (including any power to make byelaws) are to be exercised so as to secure compliance with the requirements of the Directives in relation to that site".*

In other words, a group of relevant authorities, or any individual relevant authority, may create a management plan for an EMS. Management plans should be used to help relevant authorities carry out their duties to secure compliance with the Habitats Regulations. Only one management scheme may be made for each EMS. A management scheme may be amended. An authority which has established a management scheme must as soon as practicable thereafter send a copy of it to the ANCB. Any management plans created on this site should be guided by the advice in this package.

Within their areas of jurisdiction relevant authorities must have regard to both direct and indirect effects of an activity on the designated features of the site. This may include consideration of issues outside the boundary of the site. Nothing within a Regulation 37(3) package will require relevant authorities to undertake any actions to maintain or improve the condition of designated features if it is shown that the changes result wholly from natural causes.

NRW will continue to review any new evidence or information about this site and will provide further advice as appropriate. This does not stop relevant authorities from taking any appropriate conservation measures to prevent deterioration to the designated features. Such actions should be undertaken when required.

2.3. The purpose of conservation objectives

The purpose of the conservation objectives for an EMS is to help meet the obligations of the Habitats Regulations in relation to that site. They do this by supporting:

- **Communication**. The conservation objectives help convey to stakeholders what is needed to maintain or restore a feature in/to favourable condition.
- **Site planning and management**. The conservation objectives guide the development of management measures for sites. Achievement of conservation objectives may require management action to be taken inside or outside the site boundary.
- **Assessment of plans and projects**. The Habitats Regulations require the assessment of plans and projects in view of a site's conservation objectives. Subject to certain exceptions, plans or projects may not proceed unless it is established that they will not adversely affect the integrity of a site. Conservation objectives can help develop suitable compensatory measures.
- **Monitoring and reporting**. Conservation objectives provide the basis for defining the evidence that will be used for assessing the condition of a feature.

This document includes both a statement of the conservation objectives and explanatory text on their intent and interpretation specific to the site (supporting information).

2.4. The purpose of advice on operations

NRW must provide advice to relevant authorities about operations that may cause,

- deterioration of designated natural habitats
- deterioration of the habitats of designated species
- the disturbance of designated species

This is statutory advice required by Regulation 37(3)(b) of the Habitats Regulations when considering operations which may cause impacts to designated features. These are operations which could take place within or outside the boundary of the [insert SAC/SPA].

NRW can provide specific advice on existing activities and management, advising on the extent to which activities are consistent with the conservation objectives. This advice, together with the list of activities in Section 4 and the latest condition assessments, should direct required management measures within a site.

2.5. When to use this advice

This advice should be used together with case-specific advice issued by NRW when developing, proposing or assessing an activity, plan or project that may affect the features of the site. Any proposal or operation that has the potential to affect a site must not prevent the achievement of the feature's conservation objectives. Any such prevention would amount to an adverse effect on the integrity of the site.

The advice given here is without prejudice to any advice which may be provided by NRW in relation to the consideration of individual plans or projects in the carrying out of the assessment provisions as defined in Part 6 of the Habitat Regulations.

2.6. Feature condition

NRW has a dedicated condition assessment process to assess feature condition. Each feature designated in Welsh EMS have their own set of performance indicators. These indicators have targets which are assessed with the most up to date evidence available. When all required indicator targets are met a feature is in favourable condition.

The condition assessment of a feature helps to determine if its conservation objectives are being achieved. Results determine if maintain or restore conservation objectives are needed. Appropriate management must be in place to enable conservation objectives to continue being met and for feature condition to be maintained or restored as required. The conservation objectives cannot be achieved if a feature is in unfavourable condition.

Feature condition is recorded in condition assessment documents. These are available on the NRW website. NRW will update this advice package when new condition assessment information is available.

2.6.1. Favourable conservation status and National Site Network

If features are in favourable condition, it is likely they are making an appropriate contribution to Favourable Conservation Status (FCS) of the feature at the UK level. A feature cannot make an appropriate contribution to FCS without meeting its conservation objectives. More information on FCS can be found in the joint statement from the UK Statutory Nature Conservation Bodies.

Regulation 16A of the Habitats Regulations creates the National Site Network on land and at sea, including both the inshore and offshore marine areas in the UK, and sets out the powers and duties of the appropriate authority (Welsh Government).

Information on how features in a site are meeting their conservation objectives will feed into the assessment of the National Site Network management objectives. The management objectives for the National Site Network are to maintain or restore designated SAC and SPA features to favourable conservation status across their natural range. More information on the UK National Site Network and its management objectives can be found on the gov.uk website.

2.7. Climate change and coastal squeeze

2.7.1. Vulnerability of Annex I habitats to climate change pressures

The oceans play a vital role in the global carbon cycle, and the importance of the oceans in mitigating against climate change is now widely recognised. Oaten et al. (2021) determined the vulnerability of Welsh Annex I marine features to a range of climate change pressures. The method involved developing a Geographical Information System (GIS) model using the best available climate projections and spatial data on marine habitats in Wales at that time. This was undertaken for a number of emissions scenarios and management timeframes.

A literature review on the sensitivities of Annex I habitats to physical and chemical pressures as a result of climate change was carried out which also informed the assessment. The biological resolution of Annex I habitats was considered too broad to undertake a meaningful vulnerability assessment, as individual biotopes that comprise the Annex I habitats have differing sensitivities to climate change pressures. Thus, the initial assessment was based on the vulnerabilities of component biotopes of Annex I marine habitats in Wales. The biotopes were then re-assigned to the respective features within each MPA. While it was not possible to achieve full spatial coverage of biotopes that comprise the Annex I features (due to spatial gaps in data in some of the features), the resulting data was considered to sufficiently represent the types of communities that would be found (Gihwala et al., 2024).

The climate change pressure that were assessed included:

- Air temperature
- Deoxygenation
- Ocean acidification
- Salinity
- Sea level rise
- Sea temperature
- Wave exposure

There are other pressures that have not been assessed such as those arising from the terrestrial environment for example increased river and sediment run off due to predicted higher rainfall levels.

The vulnerability categories used in the analysis were ‘Not relevant’, ‘Not sensitive’, ‘Low’, ‘Medium’ and ‘High’. The overall vulnerability score for each climate change pressure was based on the vulnerability category with the greatest spatial coverage for the respective feature (based on the underpinning biotopes). It should be noted that climate change vulnerabilities assigned to each respective feature at the site level were only based on biotope sensitivities and did not consider any local circumstances (e.g. specific management policies or existing coastal structures) and were based under an RCP 8.5 scenario – 2049 (Gihwala et al., 2024). In Section 5.1 a summary of the climate change vulnerabilities for each assessed feature on this site can be found. The full report includes the impact on Blue Carbon and maps of the different climate change pressures.

Climate change is likely to cause changes across a site and across the network of sites in Wales. There are likely to be differences in impacts across features with some features being more impacted by certain climate change pressures than others. There may also be perceived conflicts between features where potential management measures may impact one feature to the detriment of another e.g. the protection of a coastal lagoon may affect adjacent mudflats and sandflats. These challenges are difficult to address through conservation advice and a lot more thinking needs to be done on this issue. In the meantime they will need to be considered on a site-by-site basis, as and when they arise.

2.7.2. Vulnerability of coastal features to coastal squeeze

Besides the general work on climate change vulnerabilities above more specific detailed work has been carried out on the impacts of sea-level rise on our MPA network (Oaten et al., 2024). This work regards the extent to which sea-level rise may cause coastal squeeze and natural squeeze, an issue which affects intertidal habitats.

Coastal Squeeze is “The loss of natural habitats or deterioration of their quality arising from anthropogenic structures, or actions, preventing the landward transgression of those habitats that would otherwise naturally occur in response to sea level rise in conjunction with other coastal processes. Coastal Squeeze affects habitat on the seaward side of existing structures.”

Natural squeeze is defined as the loss of habitat against any natural frontage that restricts the rollback of intertidal habitats. Two types of natural frontage are considered within the assessment of natural squeeze:

- Natural Ridge – e.g., a shingle / dune ridge or a natural bank that has an area of low-lying land behind that could be inundated by the tide if the ridge is breached; and
- High ground – naturally high ground that limits any inundation of the tide into the hinterland.

Seven broad intertidal habitat groups were identified as being subjected to coastal squeeze. The following are of relevance for our marine Annex I habitats in our Welsh MPA network,

- Saltmarsh
- Mudflats and sandflats
- Intertidal reef
- Vegetated shingle.

The affected habitats for this SAC are reefs and mudflats and sandflats. Further information on the specific feature impacts is provided in Section 5.2. The different timeframes, climate change scenarios and management scenarios can be found in full assessment of coastal squeeze report.

3. Conservation objectives for Menai Strait and Conwy Bay SAC

The conservation objectives for each designated feature are outlined in the sections below. Each objective is accompanied by objective attributes and targets (see Section 1.3) and supporting information specific to each objective. General site information can be found in Appendix 1. General feature descriptions and ecological characteristics can be found in the JNCC habitats list.

The following terms are used in the conservation objectives.

Anthropogenic: In this document anthropogenic specifically relates to environmental changes caused or influenced by people, either directly or indirectly. NRW consider anthropogenic influences to include climate change.

Component habitat: Habitats that constitute the named features. E.g. Muddy gravels in mudflat and sandflats (use full feature title).

Maintain: Where existing evidence from the most recent condition assessment suggests the feature to be in favourable condition, the conservation objective is for the feature to remain in favourable condition.

Natural change: This is defined as species or habitat changes which are not a result of anthropogenic influences. NRW consider anthropogenic influences to include climate change.

Natural variability: This is defined as species or habitat variability, which are not a result of anthropogenic influences. NRW consider anthropogenic influences to include climate change.

Restore: Where existing evidence from the most recent condition assessment suggests the feature, or part of the feature, to be in unfavourable condition the conservation objective is to return the feature to favourable condition. As the feature is being returned to favourable condition, further decline in the aspects of condition that are causing it to be unfavourable should be prevented. The ability to achieve favourable condition should not be inhibited.

Structure and function: Structure encompasses both the physical structure of a habitat feature (e.g. geology and morphology), together with the biological structure, including habitat forming species (both plant and animal) and species composition. Function encompasses the ecological processes influencing the habitat feature at different temporal and spatial scales.

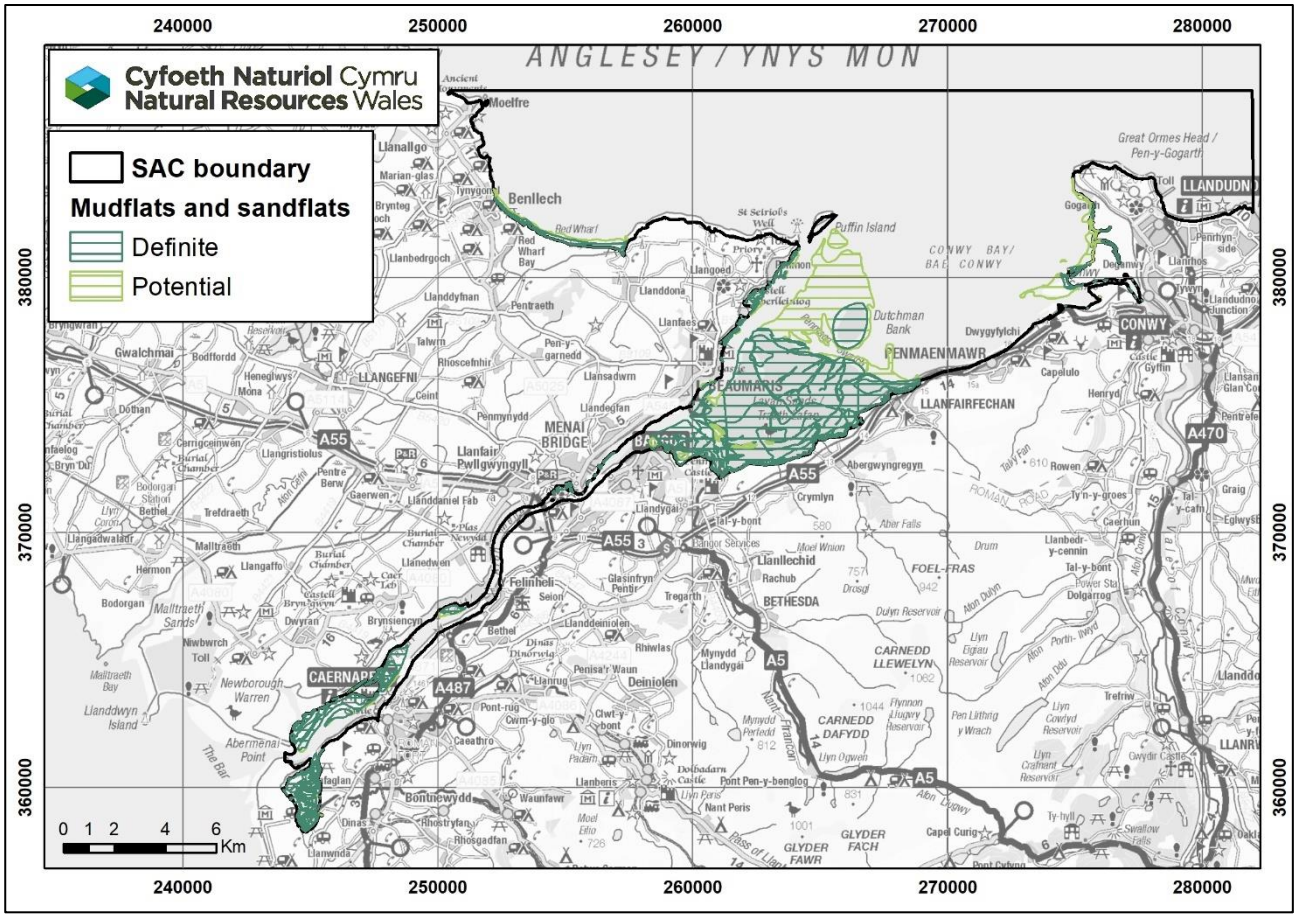
Unknown: Where there is not enough suitable evidence to conduct a condition assessment the feature is assigned an unknown condition**.**

3.1. Feature 1: Mudflats and sandflats not covered by seawater at low tide

The mudflats and sandflats not covered by seawater at low tide (mudflats and sandflats) feature within Menai Strait and Conwy Bay SAC is currently in **favourable condition** (low confidence). NRW published the latest condition assessment in June 2025. NRW will review these conservation objectives when new condition assessment information is available.

Figure 2 is a map of the location of the mudflats and sandflats feature within Menai Strait and Conwy Bay SAC. The map is for illustrative purposes only. Detailed maps for this feature in Wales can be found on Data Map Wales.

Figure 2. Map of the mudflats and sandflats feature within Menai Strait and Conwy Bay SAC.



Below are the attributes and targets for each conservation objective alongside supporting information.

Objective 1: The overall distribution and extent of the mudflats and sandflats feature within the SAC and each of its main component habitats are stable or increasing, subject to natural change.

Objective attribute	Site specific target
1a. Feature extent and distribution	Maintain the extent and distribution of mudflats and sandflats, subject to natural change.
1b. Component habitat extent and distribution	Maintain the extent and distribution of component habitats and communities necessary for the structure and function of the mudflats and sandflats feature.

Supporting information

1a. Extent and distribution

The extent describes the presence and area of the habitat across the whole site, even where it is patchy. The distribution describes the more detailed locations of the feature across the SAC. The mudflats and sandflats feature occurs throughout the SAC in the intertidal, with the most significant areas at Traeth Lafan and in Y Foryd / Foryd Bay. The extent and distribution of the littoral sediments can be determined by coastal processes and the influence of adjacent habitats and may therefore change over time.

Mudflats occur where conditions are relatively sheltered from wave-action and tidal currents. Areas of sandflat occur where exposure to tidal currents and wave-action is greater. There are large areas of tide-swept intertidal sand in the western Menai Strait and Foryd Bay. The mudflats and sandflats extent and distribution attribute is being met, allowing a maintain target to be set for objective 1a. See the latest condition assessment for more information (Jackson-Bué et al., 2025a).

1b. Component habitat extent and distribution

The mudflats and sandflats feature includes a variety of different component habitat types including sands, muds and muddy gravels. Three notable component habitats and their associated assemblages of marine plants and animals are of conservation importance are well mapped in the SAC - intertidal muddy gravels, dwarf eelgrass *Zostera noltei* beds, and intertidal sediments on Traeth Lafan.

Muddy gravel habitats occur in patches on the foreshore between Penmon and Beaumaris on the north shore of the Menai Strait and on the foreshore around Menai Bridge. There are also small areas of muddy gravels in the western Menai Strait and in Foryd Bay. Dwarf eelgrass *Zostera noltei* beds are typically found in sheltered mud and sand habitats and occur on the shore at Traeth Lafan between Glan y Mor Elias and Pwll Budr culvert. There are three areas in Foryd Bay, the largest of which is the north-western corner next to Fort

Belan. Two smaller beds are found on the eastern shore, to the north and south of the mouth of the Afon Gwyrfai. The density of grass blades varies within the SAC from being localised dense patches to larger areas of sparse, but continuous plants. Within parts of the intertidal mudflats and sandflats feature on Traeth Lafan there is a large seabed lay mussel fishery that has been operating prior to designation. Natural mussel beds occur towards the western end of Traeth Lafan, between the River Ogwen and Glan y Mor Elias.

Component habitats of the feature need to be maintained by sustaining suitable environmental conditions and limiting activities to which they may be sensitive. The recovery time of soft sediment habitats will be influenced by the type of sediment as well as the type and duration of impact. The mudflats and sandflats habitats and communities attribute is being met, allowing a maintain target to be set for objective 1b. See the latest condition assessment for more information (Jackson-Bué et al., 2025a).

Objective 2: The hydro-morphological and chemical structure necessary for the function of the mudflats and sandflats feature are stable or improving, subject to natural change.

Objective attribute	**Site specific target(s)**
2a. Water and sediment quality	Contaminants are at levels not detrimental to the structure and function of the mudflats and sandflats feature. Nutrients are at levels not detrimental to the structure and function of the mudflats and sandflats feature. Physicochemical characteristics are at levels not detrimental to the structure and function of the mudflats and sandflats feature.
2b. Hydro-morphology	The characteristic hydrodynamics, sediment transport and morphology necessary for the structure and function of the mudflats and sandflats feature are sustained.
2c. Sediment supply	The sediment type, size distribution and budget necessary for the structure and function of the mudflats and sandflats feature is sustained.

Supporting information

2a. Water and sediment quality

Various contaminants are known to affect species living within the water column and in or on the surface of sediments. The biological effect of a contaminant will vary depending on its nature. Contaminants include, but are not limited to, heavy metals (e.g. mercury and zinc), Polybrominated diphenol ethers (PBDEs), poly-aromatic hydrocarbons (PAHs), poly-

chlorinated biphenyls (PCBs) and organotin and pesticides such as hexachlorobenzene. These chemicals (e.g. heavy metals) can degrade community structure and bioaccumulate within organisms, entering the marine food chain (e.g. PCBs) (OSPAR Commission, 2012). The type of sediment present determines whether contaminants can accumulate. Mobile, loosely aggregated sands will not accumulate contaminants unlike muddy sediments. Activities that disturb sediments (e.g. dredging) can release contaminants back into the water column.

High concentrations of nutrients in the water column can cause phytoplankton and opportunistic macroalgae blooms. These blooms can lead to reduced dissolved oxygen availability especially in warmer months. This can have lethal and sub-lethal impacts on sensitive fish, epifauna and infauna communities (Best et al., 2007). The latest condition assessment found no nutrient issues impacting the feature (Jackson-Bué et al., 2025a).

Physicochemical characteristics include salinity, pH, temperature, dissolved oxygen and turbidity. They influence habitats in terms of the abundance, distribution and composition of communities present. Physicochemical characteristics can vary widely in the intertidal and shallow coastal waters, at relatively local scales. Waters across the SAC are turbid, containing a relatively high level of suspended material. Changes in any of these properties as a result of anthropogenic activities may impact habitats and the communities they support.

Some water and sediment quality issues have been identified for this feature. For more information see the latest condition assessment (Jackson- Bué et al., 2025a).

2b. Hydro-morphology

Hydro-morphology refers to patterns of water movement (caused by waves, wind, tides and fluvial input), coastal processes (e.g. erosion and deposition), and the physical characteristics of the environment. Waves and currents move sediment, which can change the shape of the seabed, which in turn can change the waves and the currents; meaning there is two-way feedback between the hydrodynamics and the morphology. As water movement transports nutrients, sediment and other particles, it also strongly influences the species and communities present.

Intertidal mudflats and sandflats are dynamic. Their distribution, extent, shape, topography, aspect and orientation are the product of complex interaction between hydrodynamic and sediment transport processes, sediment supply and coastal morphology. In shallower areas, wave driven processes largely dictate current and sediment movement, whereas lower down the profile a delicate balance of wave and tidal forcing can be important. The hydrographic functions that shape the structure of intertidal mudflats and sandflats vary on a range of timescales from shorter (e.g. storm events to spring – neap tidal cycles) to longer-term (e.g. summer – winter wave seasonality), to climatic influences. Importantly, the two-way feedback means as well as maintaining the wave and tidal forcing, maintaining the broad shape (e.g. beach type classification) of features is important.

The status of these parameters provides suitable conditions for sustaining the mudflats and sandflats feature. A change in the hydro-morphology that influences the SAC could lead to changes in extent of the habitat or the communities present, and therefore the functions of the mudflats and sandflats in the site.

No hydro-morphology issues have been identified for this feature. For more information see the latest condition assessment (Jackson- Bué et al., 2025a). Information on the hydro-morphology of the site can be found in Appendix 1.

2c. Sediment supply

Sedimentary habitats are subject to a range of deposition and erosion processes, which anthropogenic activity can influence. Most intertidal sediments stabilise over time so maintaining the sediment composition supports natural succession of the habitats and communities (Gray and Elliott, 2009). Sediment type strongly influences the species that are present within a community, for example muddy areas are highly productive, containing high levels of organic material. The size, shape, quantity and characteristics of sediments are important to the structure and function of the feature. For example, grain size can influence morphology with coarser grained areas often having steeper beach profiles.

The sedimentology of the mudflats and sandflats feature is variable throughout the site, depending on aspect, coastal topography, shore morphology, wave exposure and sediment budget present. Maintaining the natural sediment transport pathways (both quantity and sediment grain size) is important to ensure maintenance of the morphology and sediment type of intertidal sand and mudflats. Sediment budgets and transport often operate on a regional scale, and therefore projects outside the SAC can still alter the sediment supply to features within the site.

No sediment supply issues have been identified for this feature. For more information see the latest condition assessment (Jackson- Bué et al., 2025a). Information on the sediment transport within the SAC can be found in Appendix 1.

Objective 3: The abundance, distribution and diversity of communities and component habitats necessary for the structure and function of the mudflats and sandflats feature are stable or improving, subject to natural variability.

Objective attribute	**Site specific target**
3a. Habitats and communities	Maintain the abundance, distribution and diversity of species within component habitats and communities necessary for the structure and function of the mudflats and sandflats feature.
3b. Invasive and non-native species	Introduction or spread of new non-native species to the SAC by anthropogenic activities should not have a detrimental impact on the structure and function of the mudflats and sandflats feature.

Supporting information

3a. Habitats and communities

All the mudflats and sandflats communities within the SAC contribute to the overall condition of the feature. Changes to the spatial distribution of communities across the feature could highlight changes to the overall feature.

Component habitats of the feature include, intertidal muddy gravels, dwarf eelgrass *Zostera noltei* beds, and intertidal sediments on Traeth Lafan. The communities associated with the habitats of the mudflats and sandflats feature show large ecological variation, reflecting the changing conditions experienced throughout the site. Tide swept, wave-sheltered communities associated with sandbars and muddy gravels in the Menai Strait, gradually change to the moderately wave-exposed, less tide-swept communities in the more open waters of Traeth Lafan, Red Wharf Bay and Conwy Bay. Muddy areas generally support very large numbers of individuals of a few species. Diversity of species, including marine worms, tends to increase with increasing levels of sand and gravels. However, coarse sand is easily moved by waves and only a few specialist species can exist, including sandeels which may be found burrowed in intertidal sand habitats.

The infaunal communities associated with muddy gravel habitats in the Menai Strait are very diverse and highly productive. They are dominated by polychaete, oligochaete and nematode worms. Other infaunal groups include bivalves and amphipods, with various taxa represented. Epibiota include barnacles, littorinid snails, prawns, anemones and various algae (Moore et al., In draft). Traeth Lafan has a mosaic of sand and mud with vertical zonation of the marine communities from the top to the bottom of the shore, and from east to west across the shore, as wave exposure decreases and the mud content of the sediment increases. More information on communities within the mudflats and sandflats feature can be found in Appendix 1.

The mudflat and sandflat habitats and communities attribute is being met, allowing a maintain target to be set for objective 3a. See the latest condition assessment for more information (Jackson-Bué et al., 2025a).

3b. Invasive and non-native species

Non-native species (NNS) may become invasive non-native species (INNS) and displace native species by predating them or out-competing them for food, space or both. This can lead to the loss of indigenous species from certain areas or changes to community structure (JNCC, 2004; Levin et al., 2002), as well as changes to biotope and habitat type. The introduction or spread of NNS within the SAC can occur through various regulated and unregulated pathways. Further information on introduction pathways can be found on the GB non-native species secretariat website.

The American slipper limpet *Crepidula fornicata* became established around 2019 in the Menai Strait and numbers are increasing substantially. Records are within or very close to the mudflats and sandflats feature. The red seaweed *Gracilaria vermiculophylla* was recently recorded in the Traeth Lafan sandflats in the Menai Strait. However, there is limited evidence to suggest that INNS are currently having a detrimental impact on the mudflats and sandflats feature in this SAC. For more information see the latest condition assessment (Jackson-Bué et al., 2025a). Information on INNS in the SAC as a whole can be seen in Appendix 1.

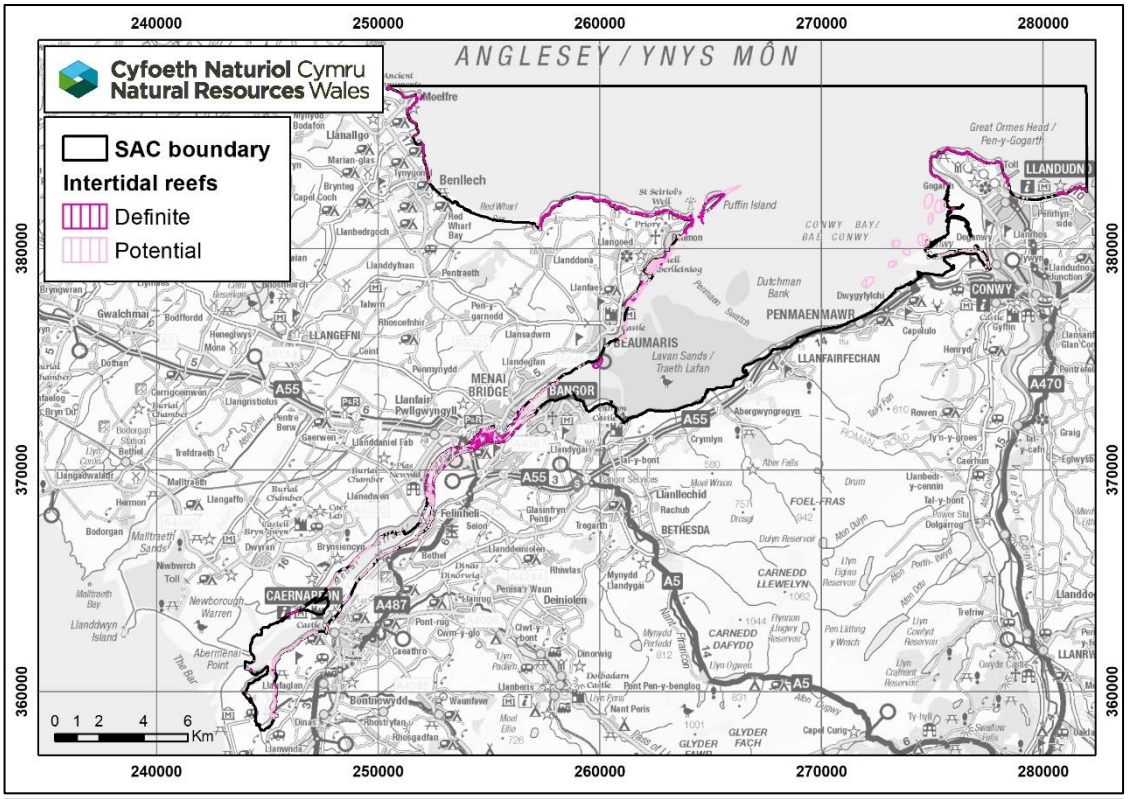
3.2. Feature 2: Reefs

The reefs feature within Menai Strait and Conwy Bay SAC is currently in **unfavourable** condition (medium confidence). NRW published the latest condition assessment in June 2025. NRW will review these conservation objectives when new condition assessment information is available.

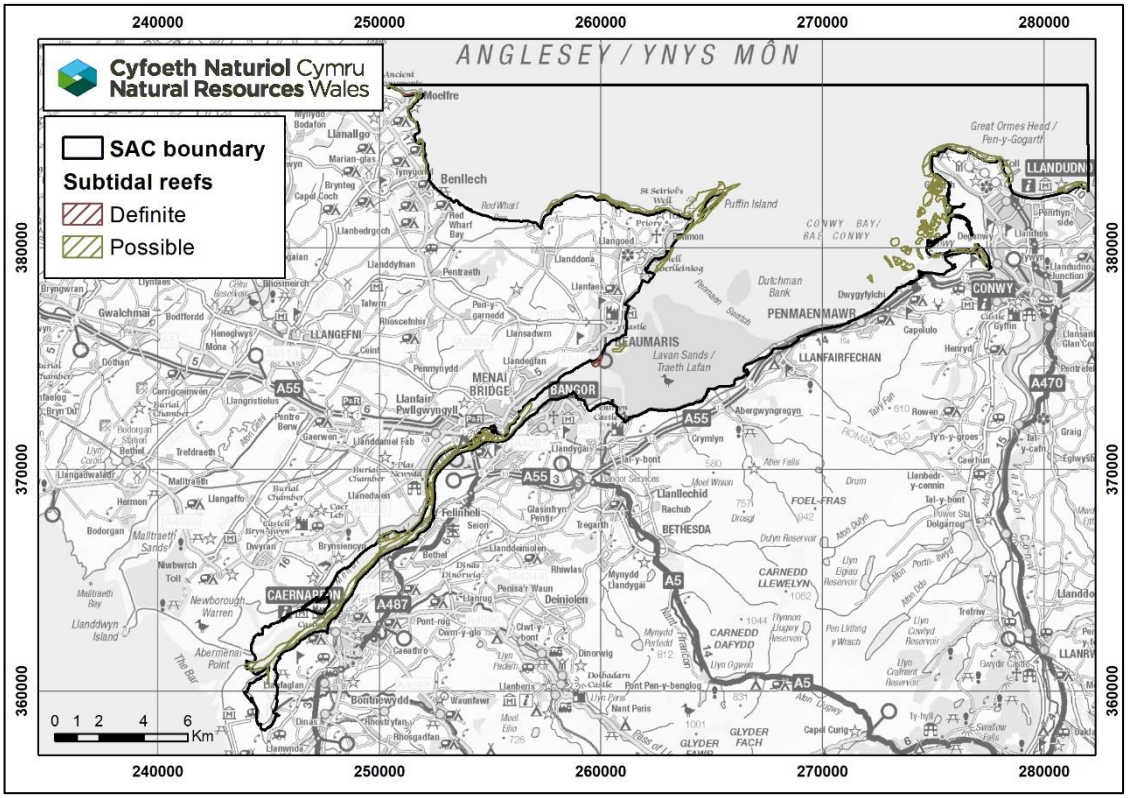
Figure 3 is a map of the location of the reefs feature within Menai Strait and Conwy Bay SAC. The map is for illustrative purposes only. Detailed maps for this feature in Wales can be found on Data Map Wales. The attributes and targets for each conservation objective, alongside supporting information, follow Figure 3.

Figure 3. Map of the reefs feature within Menai Strait and Conwy Bay SAC. a) intertidal reefs and b) Subtidal reefs.

a)



b)



Below are the attributes and targets for each conservation objective alongside supporting information.

Objective 1: The overall distribution and extent of the reefs feature within the SAC and each of its main component habitats are stable or increasing, subject to natural change.

Objective attribute	Site specific target
1a. Feature extent and distribution	Maintain the extent and distribution of the reefs feature and reef types, subject to natural change.
1b. Component habitat extent and distribution	Maintain the extent and distribution of the component habitats and communities necessary for the structure and function of the reefs feature.

Supporting information

1a. Feature extent and distribution

The extent describes the presence and area of the habitat across the whole site, even where it is patchy. The distribution describes the more detailed locations and pattern of different habitats that comprise the feature across the SAC. The reefs feature occurs throughout the SAC in intertidal and subtidal areas.

The most significant areas of intertidal reef occur around Menai Bridge, between Beaumaris and Penmon, and between Penmon and Red Wharf Bay. Around the Great and Little Ormes the reef feature extends a short distance into the subtidal. Subtidal reefs subject to particularly high tidal flows are found within the Menai Strait. At the eastern end of Conwy Bay, off the mouth of the Conwy Estuary, the reef feature occurs as areas of cobbles protruding just above sediment deposits (cobble skears). Naturally occurring mussel beds in the area known as ‘Morfa’ form small areas of biogenic reef in addition to the areas found on Traeth Lafan.

The reefs extent and distribution attribute is being met, allowing a maintain target to be set for objective 1a. See the latest condition assessment for more information (Jackson-Bué et al., 2025b).

1b. Component habitat extent and distribution

The reefs feature includes many different types of reefs, ranging from rocky to clay outcrops to ‘biogenic’ reefs formed by mussels.

The following are considered the main component reef habitats in this site:

- Reef in high energy wave-sheltered, tide-swept conditions
- Under-boulder, overhang and crevice habitats
- Limestone reef
- Clay outcrop reef

The following are also important habitats within the SAC:

- Kelp beds (also known as kelp parks or kelp forests),
- Naturally formed blue mussel beds Mytilus edulis,
- Small areas of honeycomb worm Sabellaria alveolata reef,
- Estuarine rocky habitats.

In the central Menai Strait, the hard substrata reef habitat is composed of green schist and gneiss. Exposures of carboniferous limestone are the basis of reef around the north-east coast of Anglesey, the Great and Little Ormes, in the Menai Strait along the south shore of the Swellies and subtidally on the north shore at Plas Newydd. Other areas of reef in the strait are composed of cobbles and pebbles interspersed with gravelly sand. Reef habitats within the Menai Strait are subject to high tidal flow forming a distinctive component habitat. An unusual subtidal reef habitat of clay deposits occurs subtidally near Gallows Point just west of Beaumaris and between Beaumaris and Penmon. Reef in the eastern side of Conwy Bay comprises areas of cobble skears.

More information on these habitats and communities can be found in Appendix 1.

The reefs component habitats extent and distribution attribute is being met, allowing a maintain target to be set for objective 1b. See the latest condition assessment for more information (Jackson-Bué et al., 2025b).

Objective 2: The hydro-morphological and chemical elements necessary for the structure and function of the reefs feature are stable or improving, subject to natural change.

Objective attribute	**Site specific target(s)**
2a. Water and sediment quality	Contaminants are at levels not detrimental to the structure and function of the reefs feature. Nutrients are at levels not detrimental to the structure and function of the reefs feature. Physicochemical characteristics are at levels not detrimental to the structure and function of the reefs feature.
2b. Hydro-morphology	The characteristic hydrodynamics, sediment transport and morphology necessary for the structure and function of the reefs feature are sustained.
2c. Sediment supply	The sediment type, size distribution and budget necessary for the structure and function of the reefs feature is sustained.

Supporting information

2a. Water and sediment quality

Various contaminants are known to affect species living within the water column and in or on the surface of sediments. The biological effect of a contaminant will vary depending on its nature. Contaminants include, but are not limited to, heavy metals (e.g. mercury and zinc), Polybrominated diphenol ethers (PBDEs), poly-aromatic hydrocarbons (PAHs), poly-chlorinated biphenyls (PCBs) and organotin and pesticides such as hexachlorobenzene. These chemicals (e.g. heavy metals) can degrade community structure and bioaccumulate within organisms, entering the marine food chain (e.g. PCBs) (OSPAR Commission, 2012).

High concentrations of nutrients in the water column can cause phytoplankton and opportunistic macroalgae blooms. These blooms can lead to reduced dissolved oxygen availability especially in warmer months. This can have lethal and sub-lethal impacts on sensitive fish, epifauna and infauna communities (Best et al., 2007). Overgrowth of opportunistic macroalgae species because of increased nutrient input on intertidal reef can reduce biodiversity, though the effect of grazers and wave action can help limit the impacts (Bokn et al., 2003; Worm and Lotze, 2006). High nutrient loads may be more of an issue on sheltered intertidal reef with low grazing pressure (Bokn et al., 2003).

Physicochemical characteristics include salinity, pH, temperature, dissolved oxygen and turbidity. They influence habitats alone or in combination to affect habitats in terms of the abundance, distribution and composition of communities present. Physicochemical characteristics can vary widely in the intertidal and shallow coastal waters. Waters across the SAC are turbid, containing a relatively high level of suspended material. Changes in any of these properties, as a result of anthropogenic activities, may impact habitats and the communities they support.

Some water quality issues have been identified for this feature. For more information on water and sediment quality see the latest condition assessment (Jackson- Bué et al., 2025b).

2b. Hydro-morphology

Hydro-morphology refers to patterns of water movement (caused by waves, wind, tides and fluvial input), coastal processes (e.g. erosion and deposition), and the physical characteristics of the environment. Waves and currents move sediment, which in turn can change the waves and the currents; meaning there is two-way feedback between the hydrodynamics and the morphology. As water movement transports nutrients, sediment and other particles, it also strongly influences the species and communities present.

Wave exposure varies across the SAC. Currents and tides are complicated in the Menai Strait. Tidal streams play a very important role in structuring the habitats features of the SAC and their associated species assemblages, particularly in the Menai Strait, which is one of the largest tidal rapid systems in the UK.

Morphology of hard substrata reefs is unlikely to change without direct anthropogenic action. Cobble and boulder reef morphology can also be altered by large wave events. Biogenic reef morphology can be affected by changes to the nutrient, food or sediment supply required for their maintenance, as well as storm events or anthropogenic activity.

No hydro-morphology issues have been identified for this feature. For more information see the latest condition assessment (Jackson- Bué et al., 2025b). Information on the hydro-morphology of the site can be found in Appendix 1.

2c. Sediment supply

Sediment type, distribution and supply are important in determining the species and communities present in a habitat. The rate at which sediment is deposited is known to influence reef habitats and their associated communities. Sedimentation influences community composition, alters species growth rates, inhibits feeding or photosynthesis and potentially affects reproductive success by reducing larval recruitment. High levels of sediment deposition could lead to smothering or burying of sessile benthic species. Sediment supply is important for reef forming *Sabellaria* species, as tube growth is dependent on the presence of suspended particles.

Sediment budgets and transport often operate on a regional scale, and therefore projects outside the SAC can still alter the sediment supply to features within the site.

No sediment supply issues have been identified for this feature. For more information see the latest condition assessment (Jackson- Bué et al., 2025b). Information on the sediment transport within the SAC can be found in Appendix 1.

Objective 3: The abundance, distribution and diversity of species within component habitats and communities necessary for the structure and function of the reefs feature are stable or improving, subject to natural variability.

Objective attribute	**Site specific target(s)**
3a. Habitats and communities	Maintain the abundance, distribution and diversity of species within intertidal component habitats and communities necessary for the structure and function of the reefs feature. Restore the abundance, distribution and diversity of species within subtidal component habitats and communities necessary for the structure and function of the reefs feature.
3b. Invasive and non-native species (INNS)	Introduction or spread of new non-native species to the SAC by anthropogenic activities should not have a detrimental impact on the structure and function of the reefs feature.

Supporting information

3a. Habitats and communities

All the reefs communities within the SAC contribute to the overall condition of the feature. Changes to the spatial distribution of communities across the feature could highlight changes to the overall feature.

An enormous variety of different marine animals and plants together make up communities associated with the reefs feature. Intertidally, communities show patterns of vertical zonation from the top to the bottom of the shore, reflecting differing tolerances to exposure by the tide and desiccation. Subtidally, reef communities show zonation from shallow subtidal areas into deeper water. In shallow areas, rocky reefs generally support different types of seaweed community dominated by kelps and other brown or red seaweeds. In deeper water they are dominated by animal species such as sponges, sea anemones, sea squirts, hydroids, bryozoans and molluscs. Varied assemblages of mobile species such as fish, crabs and other species are also part of the reef communities.

The following are notable reef habitats, and their associated communities of marine plants and animals are of conservation importance.

- Reef communities in high energy wave-sheltered, tide-swept conditions
- Under-boulder, overhang and crevice communities
- Limestone reef communities
- Clay outcrop reef communities

The following are also important habitat communities within the SAC:

- Kelp beds (also known as kelp parks or kelp forests),
- Naturally formed blue mussel beds Mytilus edulis,
- Small areas of honeycomb worm *Sabellaria alveolata* reef,
- Estuarine rocky habitats.

More information on each of these habitats and their communities and reef communities in general can be found in Appendix 1.

The latest condition assessment found subtidal sponge communities are in decline within the Menai Straits. There has also been a decline in species richness, diversity and taxonomic distinctness within some subtidal reefs. Therefore, the reefs habitats and communities attribute is not being met and a restore target has been set specifically for subtidal reefs for objective 3a. Intertidal reefs that make up the feature have a maintain target. For more information see the latest condition assessment (Jackson-Bué et al., 2025b).

3b. Invasive and non-native species (INNS)

Non-native species (NNS) may become invasive non-native species (INNS) and displace native species by predating them or out-competing them for food, space or both. This can lead to the loss of indigenous species from certain areas or changes to community structure (JNCC, 2004; Levin et al., 2002), as well as changes to biotope and habitat type. The introduction or spread of NNS within the SAC can occur through various regulated

and unregulated pathways. Further information on introduction pathways can be found on the GB non-native species secretariat website.

The American slipper limpet *Crepidula fornicata* became established around 2019 in the Menai Strait and numbers are increasing substantially within the reefs feature. Other non-native species have previously been identified in the Menai Strait (within the reefs feature) including: the Chilean oyster *Ostrea chilensis*, Pacific oyster *Magallana gigas* and wireweed *Sargassum muticum*. There is currently limited evidence to suggest that INNS are having a detrimental impact on the reefs feature. For more information see the latest condition assessment (Jackson-Bué et al.,2025b).

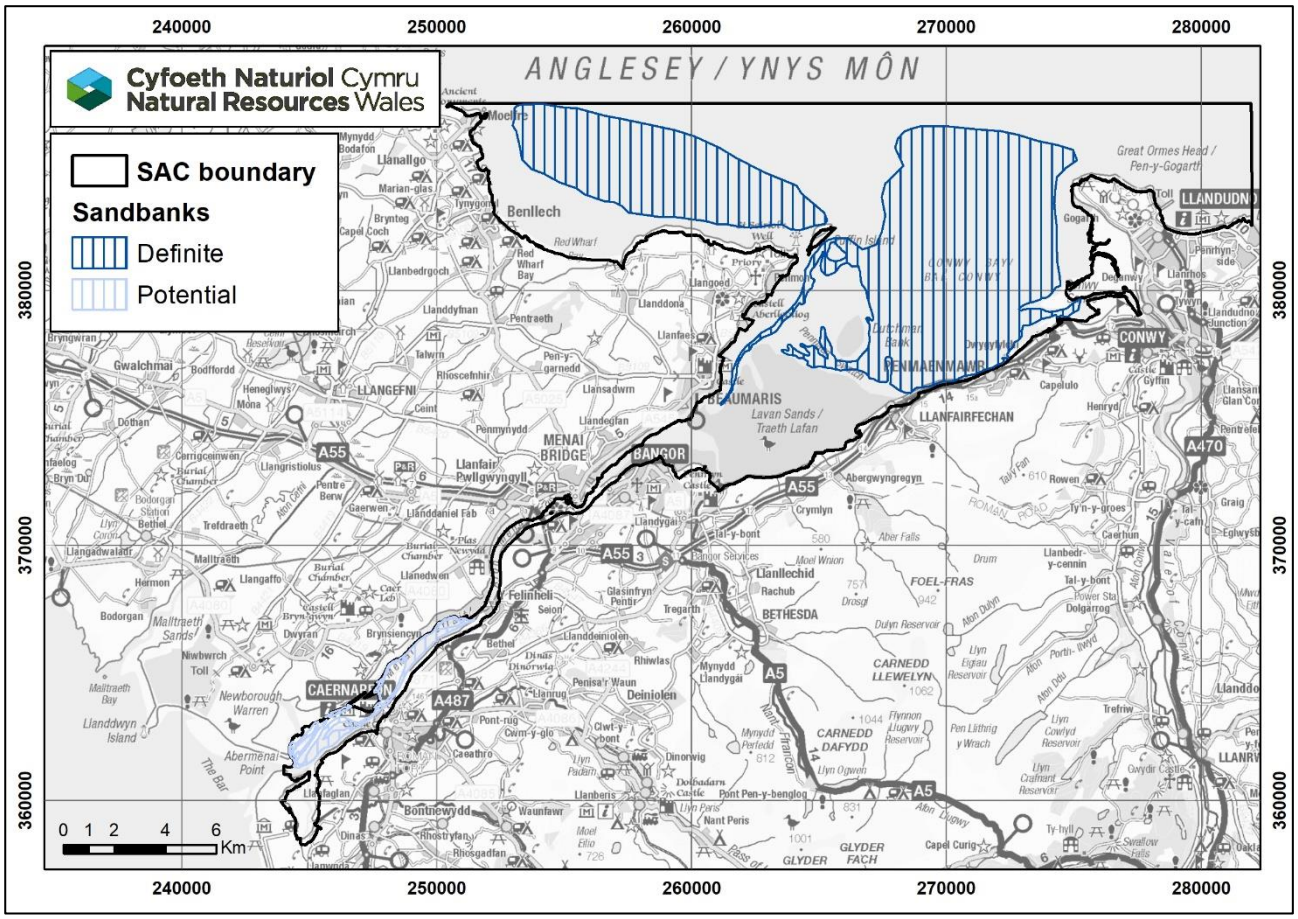
Information on INNS in the SAC as a whole can be seen in Appendix 1.

3.3. Feature 3: Sandbanks which are slightly covered by seawater all the time

The sandbanks which are slightly covered by seawater all the time (sandbanks) feature within Menai Strait and Conwy Bay SAC is currently in **unfavourable** condition (medium confidence). NRW published the latest condition assessment in June 2025. NRW will review these conservation objectives when new condition assessment information is available.

Figure 4 is a map of the location of the sandbanks feature within Menai Strait and Conwy Bay SAC. The map is for illustrative purposes only. Detailed maps for this feature in Wales can be found on Data Map Wales.

Figure 4. Map of the sandbanks feature within Menai Strait and Conwy Bay SAC.



Below are the attributes and targets for each conservation objective alongside supporting information.

Objective 1: The overall distribution and extent of the sandbanks feature within the SAC is stable or increasing, subject to natural change.

Objective attribute	Site specific target
1a. Feature extent and distribution	Maintain the extent and distribution of each of the sandbanks that form the sandbanks feature.

Supporting information

1a. Feature extent and distribution

The extent describes the presence and area of the habitat across the whole site, even where it is patchy. The distribution describes the more detailed locations and pattern of different habitats that comprise the feature across the SAC. The subtidal sandbanks feature occurs in three main areas within the SAC. Any bank in the site that meets the Annex I criteria of a sandbank is part of the feature of the site.

The Menai Strait sandbanks occur at the northern and southern entrances to the Menai Strait, adjacent to large areas of intertidal sandflat. To the north this includes Penmaen Swatch, and to the south the subtidal sediments between Felinheli and Abermenai Point.

The Conwy Bay Bank (“Four Fathom Bank” on Admiralty Charts) is located to the west of the Great Orme, extending southward into Conwy Bay. It runs roughly east/west for over 6km and varies in depth from 7-17m. The distribution and extent of Conwy Bay Bank are probably determined by the presence of the prominent headland of the Great Orme.

The Red Wharf Bay Bank occurs north of Red Wharf Bay and includes Ten Feet Bank near Puffin Island (also referred to as “Four Fathom Bank” on Admiralty Charts), these are quite mobile sandbanks. The Bank extends northwest/ south-east for over 12km from the western side of Puffin Island. The crest of the sandbank is generally at a depth of around 7m, although close to Puffin Island depths are shallower at around 2m. This sandbank extends into waters around 15m deep on the seaward side. The distribution and extent of Red Wharf Bay Bank are most likely the result of the shelter Point Lynas headland and Puffin Island provide from tidal streams.

The sandbanks extent and distribution attribute is being met, allowing a maintain target to be set for objective 1a. See the latest condition assessment for more information (Jackson-Bué et al., 2025d).

Objective 2: The hydro-morphological and chemical elements necessary for the structure and function of the sandbanks feature are stable or improving, subject to natural change.

Objective attribute	Site specific target(s)
2a. Water and sediment quality	Contaminants are at levels not detrimental to the structure and function of the sandbanks feature. Nutrients are at levels not detrimental to the structure and function of the sandbanks feature. Physicochemical characteristics are at levels not detrimental to the structure and function of sandbanks the feature.
2b. Hydro-morphology	The characteristic hydrodynamics, sediment transport and morphology necessary for the structure and function of the sandbanks feature are sustained.
2c. Sediment supply	The sediment type, size distribution and budget necessary for the structure and function of the sandbanks feature are sustained.

Supporting information

2a. Water and sediment quality

Various contaminants are known to affect species living within the water column and in or on the surface of sediments. The biological effect of a contaminant will vary depending on its nature. Contaminants include, but are not limited to, heavy metals (e.g. mercury and zinc), Polybrominated diphenol ethers (PBDEs), poly-aromatic hydrocarbons (PAHs), poly-chlorinated biphenyls (PCBs) and organotin and pesticides such as hexachlorobenzene. These chemicals (e.g. heavy metals) can degrade community structure and bioaccumulate within organisms, entering the marine food chain (e.g. PCBs) (OSPAR Commission, 2012).

Much of the sandbank feature lies outside of WFD waterbodies and outside of the 1 nautical mile from mean high water routine sampling area. Accumulation of sediments in sandbanks is likely to be minimal due to the coarse and mobile nature of the sand. Dilution effects of chemicals are also likely.

High concentrations of nutrients in the water column can cause phytoplankton and opportunistic macroalgae blooms. These blooms can smother the sediment, reducing oxygen availability. This can have lethal and sub-lethal impacts on sensitive fish, epifauna and infauna communities (Best et al., 2007). However, sandbanks may be at lower risk from issues caused by excess nutrients.

Physicochemical characteristics include salinity, pH, temperature, dissolved oxygen and turbidity. They influence habitats in terms of the abundance, distribution and the composition of communities present. Physicochemical characteristics can vary widely in the intertidal and shallow coastal waters, at relatively local scales. Changes in any of these properties, as a result of anthropogenic activities, may impact habitats and the communities they support.

Some water quality issues have been identified for this feature. For more information on water and sediment quality see the latest condition assessment (Jackson- Bué et al., 2025d).

2b. Hydro-morphology

Hydro-morphology refers to patterns of water movement (caused by waves, wind, tides and fluvial input), coastal processes (e.g. erosion and deposition), and the physical characteristics of the environment. Waves and currents move sediment, which can change the shape of the seabed, which in turn changes waves and currents; meaning there is two-way feedback between the hydrodynamics and the morphology. As water movement transports nutrients, sediment and other particles, it also strongly influences the species and communities present.

The sandbanks forming the subtidal sandbanks feature of the SAC are dynamic and their distribution and extent are determined by tidal currents, wave-driven processes, sediment transport processes and sediment availability. The subtidal sandbanks in Conwy Bay and Red Wharf Bay are subject to slower tidal streams than the Menai Strait banks and, compared to other sandbanks in Wales, are relatively sheltered from wave action, due to the protection provided by the rocky headlands of Point Lynas and the Great Orme. Unlike many headland associated sandbanks, their position is not determined by residual current or sediment transport gyres (Davis et al., 2023); therefore, they are not considered to be distinct from other seabed sediments in the area but are extensions of the shallow coastal sediments adjacent to the coastline within the two bays and part of the wider sediment system within the bays.

The subtidal banks in the Menai Strait are primarily in the south of the Strait; similar to the banks in Conwy Bay and Red Wharf Bay, they are not considered to be distinct from other seabed sediments in the area but are extensions of the shallow coastal sediments.

Sandbanks often have smaller rhythmic morphological features (described as ripples, mega-ripples or sand waves depending on length scales) superimposed on the bank morphology. These smaller features are important to water flow and sediment transport around or over the sandbanks.

No hydro-morphology issues have been identified for this feature. For more information see the latest condition assessment (Jackson- Bué et al., 2025d). Information on the hydro-morphology of the site can be found in Appendix 1.

2c. Sediment supply

The size, shape, aspect and orientation, as well as the macro- and micro-topography and sediment characteristics of sandbanks are largely determined by the sediment supply and the influence of the hydrodynamic processes affecting each bank. They change shape over time and while some are ephemeral, most large banks are relatively stable and long-

established. Mobile sediments that form temporary sandbanks are sediments associated with the feature that should be retained in the system, although their location may change.

The Menai Strait Banks are subject to strong tidal currents and are therefore composed of very clean, mobile sand with variable topography over time. In areas of high energy, such as the central channel of the strait, sediments are composed of medium sands. In areas of lower energy, in Beaumaris Bay at the northern end of the strait and in the southern Menai Strait the subtidal sandbanks are composed of predominantly fine sand. The shallowest parts of the sandbanks in the southern end of the strait and around the area of Afon Seiont at Caernarfon are composed of very fine sediments, possibly due to silt and clay from the river.

Sediment budgets and transport often operate on a regional scale, and therefore projects outside the SAC can still alter the sediment supply to features within the site.

No sediment supply issues have been identified for this feature. For more information see the latest condition assessment (Jackson- Bué et al., 2025d). Information on the sediment transport within the SAC can be found in Appendix 1.

Objective 3: The abundance, distribution and diversity of species within component habitats and communities necessary for the structure and function of the sandbanks feature are stable or improving, subject to natural variability.

Objective attribute	**Site specific target**
3a. Habitats and communities	Restore the abundance, distribution and diversity of species within habitats and communities necessary for the structure and function of the sandbanks feature.
3b. Invasive and non-native species	Introduction or spread of new non-native species to the SAC by anthropogenic activities should not have a detrimental impact on the structure and function of the sandbanks feature.

Supporting information

3a. Habitats and communities

Biological processes and interactions such as competition and predation play an important structural and functional role in influencing the assemblages of marine species associated with the subtidal sandbanks feature throughout the SAC.

Sandbanks within the Menai Strait itself are subject to strong tidal currents and are therefore composed of very clean, mobile sand. As a result, the associated communities are characterised by a very sparse infauna and epifauna consisting mainly of bristleworms, and some fish species.

Red Wharf and Conwy Bay sandbanks are known to be nursery, feeding and spawning areas for a variety of fish species (Campanella and van der Kooij, 2021; Ellis et al., 2000; 2012). They form part of the infaunal and epifaunal community of the sandbanks feature.

Communities in the sandbanks are considered a continuation of the sediment communities in the LSIB feature where they overlap. For more information on LSIB communities see Appendix 1.

In the latest condition assessment, broad scale survey monitoring analysis showed elevated numbers of opportunistic species such as the polychaetes and the oligochaetes, in the sandbank in the eastern part of Conwy Bay. The WFD Infaunal Quality Index (IQI) failed in to meet its objective in the Conwy Bay waterbody in 2015 and 2021 where the sandbank is situated. The broad scale monitoring and IQI results suggest poor environmental conditions, most likely caused by anthropogenic disturbance. Therefore the sandbanks habitats and communities attribute is not being met and a restore target has been set for objective 3a. This restore is specifically for the negative shift in species composition in the eastern part of Conwy Bay. For more detail see the latest condition assessment (Jackson-Bué et al., 2025x).

3b. Invasive and non-native species

Non-native species (NNS) may become invasive non-native species (INNS) and displace native species by predating them or out-competing them for food, space or both. This can lead to the loss of indigenous species from certain areas or changes to community structure (JNCC, 2004; Levin et al., 2002), as well as changes to biotope and habitat type. The introduction or spread of NNS within the SAC can occur through various regulated and unregulated pathways. Further information on introduction pathways can be found on the GB non-native species secretariat website.

The American slipper limpet *Crepidula fornicata* became established around 2019 in the Menai Strait. Records are within or very close to the Menai Strait sandbanks. Two individuals of the American Jack knife razor clam *Ensis leei* were found at one station in 2019 in the sandbank in Conwy Bay, west of the Great Orme head.

There is currently limited evidence to suggest that INNS are having a detrimental impact on the sandbanks feature. For more information see the latest condition assessment (Jackson-Bué et al., 2025d).

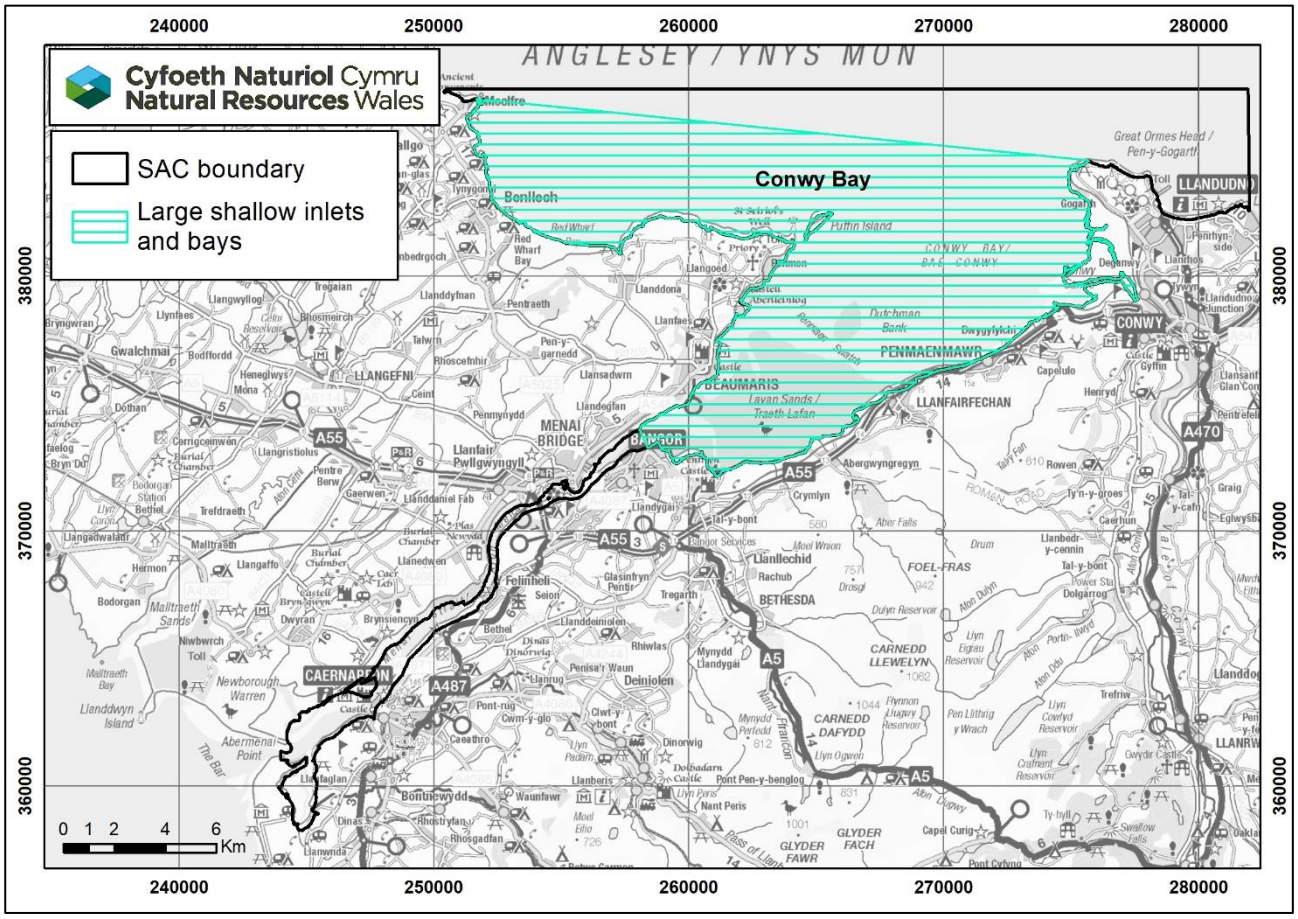
Information on INNS in the SAC as a whole can be seen in Appendix 1.

3.4. Feature 4: Large shallow inlets and bays

The large shallow inlets and bays (LSIB) feature within Menai Strait and Conwy Bay SAC is currently in **unfavourable** condition (medium confidence). NRW published the latest condition assessment in June 2025. NRW will review these conservation objectives when new condition assessment information is available.

Figure 5 is a map of the location of the LSIB feature within Menai Strait and Conwy Bay SAC. The map is for illustrative purposes only. Detailed maps for this feature in Wales can be found on Data Map Wales.

Figure 5. Map of the LSIB feature within Menai Strait and Conwy Bay SAC.



Below are the attributes and targets for each conservation objective alongside supporting information.

Objective 1: The overall distribution and extent of the large shallow inlets and bays feature within the SAC and each of its main component habitats are stable or increasing, subject to natural change.

Objective attribute	Site specific target
1a. Feature extent and distribution	Maintain the extent and distribution of the large shallow inlets and bays feature, subject to natural change.
1b. Component habitat extent and distribution	Maintain the extent and distribution of component habitats and communities necessary for the structure and function of the large shallow inlets and bays feature.

Supporting information

1a. Feature extent and distribution

The extent describes the presence and area of the habitat across the whole site, even where it is patchy. The distribution describes the more detailed locations and pattern of different habitats that comprise the feature across the SAC.

The LSIB feature of the SAC incorporates the area at the northern end of the Menai Strait extending to Bangor pier, Red Wharf Bay and Conwy Bay. It is approximately 13 nautical miles wide between the Great Orme and Moelfre and about 5 nautical miles across the greatest north-south dimension of the feature.

The LSIB extent and distribution attribute is being met, allowing a maintain target to be set for objective 1a. See the latest condition assessment for more information (Jackson-Bué et al., 2025c).

1b. Component habitat extent and distribution

Within the LSIB there are several component habitats, which are indicated by the general distribution of different sediment types, including hard substrata, sands, muds and muddy gravels. Component habitats include other Annex I habitats designated in the site (intertidal mudflats and sandflats, reefs, sandbanks and sea caves).

Component habitats of the feature need to be maintained by sustaining suitable environmental conditions and limiting activities to which they may be sensitive. The recovery of soft sediment habitats will be influenced by the type of sediment as well as the type and duration of an impact.

The shoreline of the LSIB feature is mostly rocky. These areas do not extend far into the subtidal zone as 98% of the seabed is covered in soft sediment. Small areas of subtidal reef occur in the eastern Menai Strait, consisting of clay outcrops bored by piddock. There are also areas of partly sand-covered cobble skears on the eastern side of Conwy Bay.

In general the seabed is gently shelving with water depths mostly less than 20m although down to 30m in places. Subtidally, the sediments range from coarse 'lag' gravels covered with a thin layer of sand, to areas of sand formed into small sand ribbons and larger sand waves. In some areas these develop into sandbanks. There are also important areas of organically enriched muddy sand patches inshore of the sandbanks.

The LSIB extent and distribution of component habitats and communities attribute is being met, allowing a maintain target to be set for objective 1b. See the latest condition assessment for more information (Jackson-Bué et al., 2025c).

Objective 2: The hydro-morphological and chemical elements necessary for the structure and function of the large shallow inlets and bays feature are stable or improving, subject to natural change.

Objective attribute	**Site specific target(s)**
2a Water and sediment quality	Contaminants are at levels not detrimental to the structure and function of the large shallow inlets and bays feature. Nutrients are at levels not detrimental to the structure and function of the large shallow inlets and bays feature. Physicochemical characteristics of the water column and sediments are at levels not detrimental to the structure and function of the large shallow inlets and bays feature.
2b. Hydro-morphology	The characteristic hydrodynamics, sediment transport and morphology necessary for the structure and function of the large shallow inlets and bays feature are sustained.
2c. Sediment supply	The sediment type, size distribution and budget necessary for the structure and function of the large shallow inlets and bays feature is sustained.

Supporting information

2a. Water and sediment quality

Various contaminants are known to affect species living within the water column and in or on the surface of sediments. The biological effect of a contaminant will vary depending on its nature. Contaminants include, but are not limited to, heavy metals (e.g. mercury and zinc), Polybrominated diphenol ethers (PBDEs), poly-aromatic hydrocarbons (PAHs), poly-chlorinated biphenyls (PCBs) and organotin and pesticides such as hexachlorobenzene. These chemicals (e.g. heavy metals) can degrade community structure and bioaccumulate within organisms, entering the marine food chain (e.g. PCBs) (OSPAR Commission, 2012).

High concentrations of nutrients in the water column can cause phytoplankton and opportunistic macroalgae blooms. These blooms can lead to reduced dissolved oxygen availability especially in warmer months. This can have lethal and sub-lethal impacts on sensitive fish, epifauna and infauna communities (Best et al., 2007).

Physicochemical characteristics include salinity, pH, temperature, dissolved oxygen and turbidity. They influence habitats in terms of the abundance, distribution and composition of communities present. Physicochemical characteristics can vary widely in the intertidal and shallow coastal waters. Waters across the SAC are turbid, containing a relatively high level of suspended material. Changes in any of these properties, as a result of anthropogenic activities, may impact habitats and the communities they support.

Some water quality issues have been identified for this feature. For more information on water and sediment quality see the latest condition assessment (Jackson- Bué et al., 2025c).

2b. Hydro-morphology

Hydro-morphology refers to patterns of water movement (caused by waves, wind, tides and fluvial input), coastal processes (e.g. erosion and deposition), and the physical characteristics of the environment. Waves and currents move sediment, which in turn can change the waves and the currents; meaning there is two-way feedback between the hydrodynamics and the morphology. As water movement transports nutrients, sediment and other particles, it also strongly influences the species and communities present.

The types of sediment and hard substrata habitats within the LSIB are largely determined by the underlying geology and sedimentology. They are also influenced by the dominant physical conditions, such as the degree of exposure to wave action and tidal currents. The variety of species in inlets and bays is often high as a result of wide habitat variety, the wide range of wave exposure, current strength, depth, light and substrate type, and presence of habitats that support high diversity.

A change in these environmental conditions could detrimentally affect the quality and variety, and therefore functions, of the subtidal sandbanks and intertidal mudflats and sandflats in the site.

No hydro-morphology issues have been identified for this feature. For more information see the latest condition assessment (Jackson- Bué et al., 2025c). Information on the hydro-morphology of the site can be found in Appendix 1.

2c. Sediment supply

Sediment size and structure are primary factors in determining biological communities present. Sediment topography is the product of sediment structure and sediment transport determined by hydrodynamic process and these can vary with short and long-term natural cycles.

Sediment type will also determine whether contaminants can accumulate. Unlike muddy sediments, contaminants will not usually accumulate in mobile, loosely aggregated sands. Activities that disturb sediments can release contaminants back into the water column.

Sediment budgets and transport are often on a regional scale, and therefore projects outside the SAC can still alter the sediment supply to features within the site.

No sediment supply issues have been identified for this feature. For more information see the latest condition assessment (Jackson- Bué et al., 2025c). Information on the sediment transport within the SAC can be found in Appendix 1.

Objective 3: The abundance, distribution and diversity of species within component habitats and communities necessary for the structure and function of the large shallow inlets and bays feature are stable or improving, subject to natural variability.

Objective attribute	**Site specific target**
3a. Habitats and communities	Restore the abundance, distribution and diversity of species within component habitats and communities necessary for the structure and function of the large shallow inlets and bays feature
3b. Invasive and non-native species	Introduction or spread of new non-native species to the SAC by anthropogenic activities should not have a detrimental impact on the structure and function of the large shallow inlets and bays feature.

Supporting information

3a. Habitats and communities

Extensive areas of designated Annex I features, intertidal mudflats and sandflats, Atlantic salt meadow, and reef form a mosaic throughout the feature. All the communities within the LSIB feature contribute to the overall condition of the feature. However, two notable habitats and their associated assemblages of marine plants and animals are of particular conservation importance, namely;

- Communities associated with areas of organically enriched muddy sand on the south-western side of Red Wharf Bay and the eastern side of Conwy Bay
- Subtidal and intertidal sediments believed to be of importance as a spawning, nursery and feeding grounds for a variety of fish species (Campanella and van der Kooij, 2021; Ellis et al., 2012). See appendix 1 for more information.

The biomass of species and communities in areas of enriched muddy sand is higher than on the adjacent more tide-swept sands and gravelly sands. These areas are dominated by deposit-feeders as well as being associated with mobile echinoderm and gastropods species. Many of these species are opportunistic, with short life spans and high production rates, therefore, the fauna of the inshore muddy sands is liable to be quite variable from year to year.

For more information on communities of the LSIB feature see Appendix 1. Information on habitats and communities of Annex I features found within the LSIB can be found in the corresponding conservation objectives.

In the latest condition assessment, broad scale survey monitoring analysis showed elevated numbers of opportunistic species such as the polychaetes and the oligochaetes, especially in the eastern part of Conwy Bay, southwest of the Great Ormes Head. The WFD Infaunal Quality Index (IQI) failed in to meet its objective in the Conwy Bay waterbody in 2015 and 2021. The broad scale monitoring and IQI results suggest poor environmental conditions, most likely caused by anthropogenic disturbance. Therefore the habitats and communities attribute is not being met and a restore target has been set for objective 3a. This restore is specifically for the negative shift in species composition in the eastern part of Conwy Bay. For more detail see the latest condition assessment (Jackson-Bué et al., 2025c).

3b. Invasive and non-native species

Non-native species (NNS) may become invasive non-native species (INNS) and displace native species by predating them or out-competing them for food, space or both. This can lead to the loss of indigenous species from certain areas or changes to community structure (JNCC, 2004; Levin et al., 2002), as well as changes to biotope and habitat type. The introduction or spread of NNS within the SAC can occur through various regulated and unregulated pathways. Further information on introduction pathways can be found on the GB non-native species secretariat website.

The red seaweed worm wart weed *Gracilaria vermiculophyllum* was recently recorded in the Traeth Lafan sandflats in the Menai Strait, which is within the LSIB feature. However, there is currently limited evidence to suggest that INNS are having a detrimental impact on the LSIB feature. For more information see the latest condition assessment (Jackson-Bué et al., 2025c).

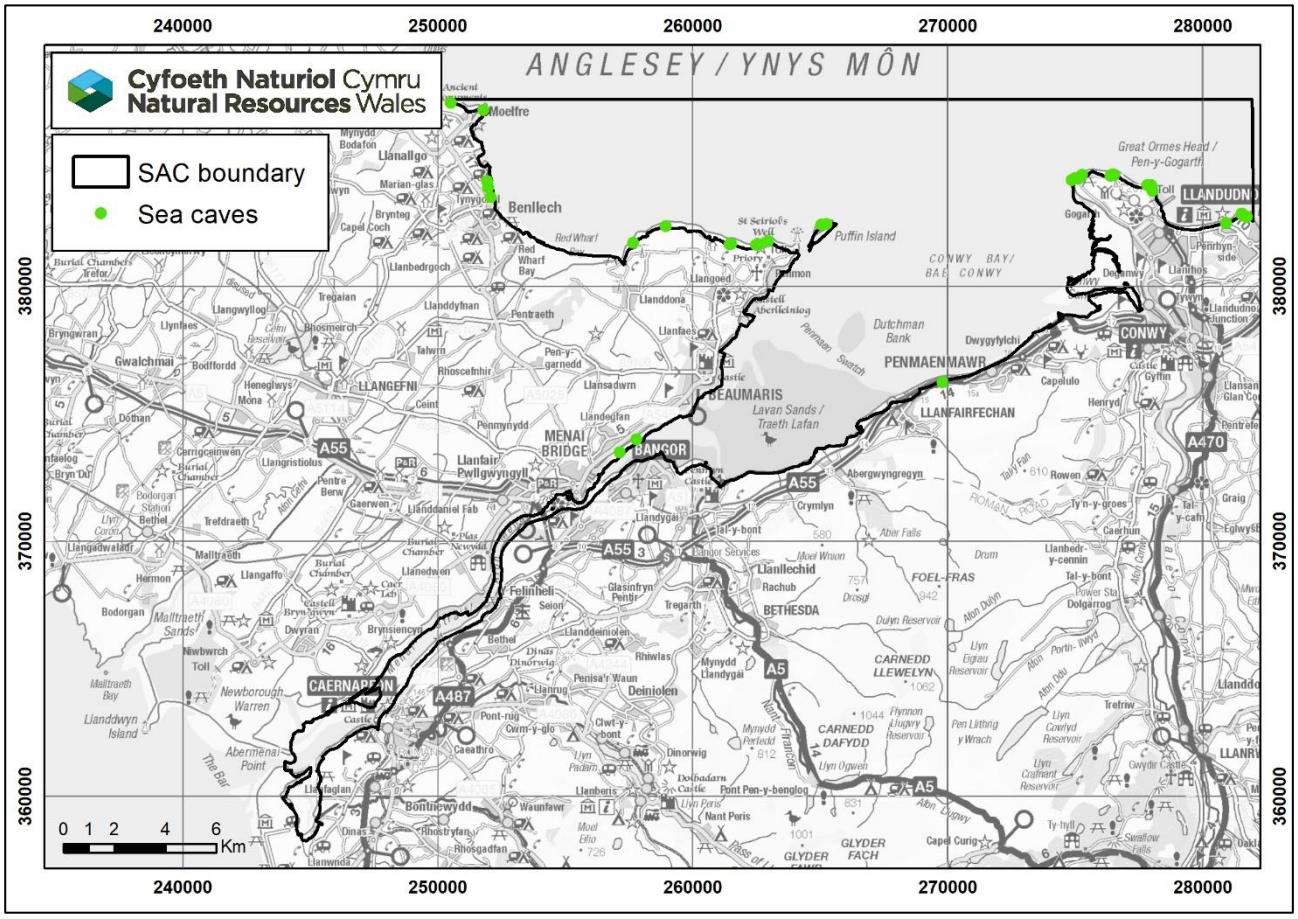
Information on INNS in the SAC as a whole can be seen in Appendix 1.

3.5. Feature 5: Submerged or partially submerged sea caves

The submerged or partially submerged sea caves (sea caves) feature within Menai Strait and Conwy Bay SAC is currently in **unknown** condition. NRW published the latest condition assessment in June 2025. NRW will review these conservation objectives when new condition assessment information is available.

Figure 6 is a map of the location of the sea caves feature within Menai Strait and Conwy Bay SAC. The map is for illustrative purposes only. Detailed maps for this feature in Wales can be found on Data Map Wales.

Figure 6. Map of the sea caves feature within Menai Strait and Conwy Bay SAC.



Below are the attributes and targets for each conservation objective alongside supporting information.

Objective 1: The overall distribution and extent of the sea caves feature within the SAC are stable subject to natural change.

Objective attribute	Site specific target
1a. Feature extent and distribution	Maintain the extent and distribution of sea caves, subject to natural change.

Supporting information

1a. Feature extent and distribution

The extent describes the presence and area of the habitat across the whole site, even where it is patchy. The distribution describes the more detailed locations and pattern of different habitats that comprise the feature across the SAC. The sea caves feature can be both intertidal and subtidal and occurs along the SAC coast and offshore islands.

Sea caves are present in areas of limestone, with the main concentrations in the north-facing cliffs of the Great and Little Ormes and the north-east coast of Anglesey between and Penmon and Red Wharf Bay, including the offshore islands. The exact number and nature of caves within the SAC (particularly those with subtidal elements or in inaccessible parts of the coast, such as offshore islands) is unknown.

Around the Great and Little Ormes, sea caves range from wave-cut indentations and clefts in the base of the cliffs, to fully formed caves and tunnels, some over 30m long, often with multiple entrances and complex architecture. The cave floors are generally composed of mobile boulders and cobbles with sand while the cave walls generally show some degree of scouring. Caves between Penmon and Red Wharf Bay, including the offshore islands occur as clefts and tunnels in the limestone bedrock. Subtidal caves may also occur here, but survey work is required to ascertain whether or not this is the case.

The sea caves extent and distribution attribute is being met, allowing a maintain target to be set for objective 1a. For more information see the latest condition assessment (Hatton-Ellis et al., 2025).

Objective 2: The hydro-morphological and chemical elements necessary for the structure and function of the sea caves feature are stable or improving, subject to natural change.

Objective attribute	**Site specific target(s)**
2a. Water and sediment quality	Contaminants are at levels not detrimental to the structure and function of the sea caves feature. Nutrient concentrations are at levels not detrimental to the structure and function of the sea caves feature. Physio-chemical characteristics of the water column and sediments are at levels not detrimental to the structure and function of the sea caves feature.
2b. Hydro-morphology	Ensure the characteristic hydrodynamics, sediment transport and morphology necessary for the structure and function of the sea caves feature are sustained.
2c. Sediment supply	The sediment type, size distribution and budget necessary for the structure and function of the sea caves feature are sustained.

Supporting information

2a. Water and sediment quality

Various contaminants are known to affect species living within the water column and in or on the surface of sediments. The biological effect of a contaminant will vary depending on its nature. Contaminants include, but are not limited to, heavy metals (e.g. mercury and zinc), Polybrominated diphenol ethers (PBDEs), poly-aromatic hydrocarbons (PAHs), poly-chlorinated biphenyls (PCBs) and organotin and pesticides such as hexachlorobenzene. These chemicals (e.g. heavy metals) can degrade community structure and bioaccumulate within organisms, entering the marine food chain (e.g. PCBs) (OSPAR Commission, 2012).

High concentrations of nutrients in the water column can cause phytoplankton and opportunistic macroalgae blooms, leading to reduced dissolved oxygen availability. This can impact sensitive fish, epifauna and infauna communities. Overgrowth of opportunistic macroalgae species that occurs because of increased nutrient input on intertidal reef can reduce biodiversity through smothering, though the effect of grazers and wave action can help limit the impacts (Bokn et al., 2003; Worm and Lotze, 2006). High nutrient loads may be more of an issue on sheltered intertidal reef with low grazing pressure (Bokn et al., 2003). The situation is likely to be the same for sheltered intertidal sea caves.

Physicochemical characteristics include salinity, pH, temperature, dissolved oxygen and turbidity. They influence habitats alone or in combination to affect habitats in terms of the abundance, distribution and composition of communities present. Physicochemical characteristics can vary widely in the intertidal and shallow coastal waters, at relatively local scales. Waters across the SAC are turbid, containing a relatively high level of suspended material. Changes in any of these properties, as a result of anthropogenic activities, may impact habitats and the communities they support.

Information on water quality can be found in the latest condition assessment (Hatton-Ellis et al., 2025).

2b. Hydro-morphology

Hydro-morphology refers to patterns of water movement (caused by waves, wind, tides and fluvial input), coastal processes (e.g. erosion and deposition), and the physical characteristics of the environment. Waves and currents can move sediment, which in turn can change the waves and the currents; meaning there is two-way feedback between the hydrodynamics and the morphology. As water movement transports nutrients, sediment and other particles, it also strongly influences the species and communities present.

The most important structure and function characteristics for the sea caves feature are the geology and geomorphology, including topography (surface features), together with hydrodynamic processes (wave action and tidal currents) and water quality and clarity (turbidity). Sea cave morphology and topography is varied and determined by the underlying geology. Microtopography is a further important dimension to habitat variation. Cave surfaces range from smooth, unbroken rock walls to fractured, fissured and perforated surfaces.

Sea caves in the Menai Strait and Conwy Bay SAC differ from those found elsewhere in Wales, predominantly due to differences in rock type, increased turbidity and exposure to wave action and tidal currents.

Caves on the shore and in the shallow sublittoral zone are frequently subject to conditions of strong wave surge and tend to have floors of coarse sediment, cobbles and boulders, which often scour the cave walls. Caves that occur in deeper water are subject to less water movement from the surrounding sea, and silt may accumulate on the cave floor. Information on the hydro-morphology of the SAC can be found in Appendix 1.

2c. Sediment supply

Sediment type, distribution and supply are important in determining the species and communities present in a habitat. The rate at which sediment is deposited is known to influence sea cave habitats and their associated communities. Sedimentation influences community composition, alter species growth rates, inhibit feeding or photosynthesis and potentially affect reproductive success by reducing larval recruitment. High levels of sediment deposition could lead to smothering or burying of sessile benthic species. Deposition of contaminated sediments has the potential to negatively impact sea cave communities.

The mobilisation and deposition of sediment as a result of water movement is regular and widespread and can lead to rapid fluctuations in sediment height. The floors of many sea caves are covered by areas of sediment or mixtures of sediment and pebbles, cobbles and boulders, with sheltered locations in caves tending to accumulate silt. The sediments

contribute to the habitat and species diversity and composition and have a strong influence on the amount of scouring of cave walls. Sea caves subject to water movement with a sediment floor, or nearby sediment source, generally have significantly higher suspended particulate concentration levels compared to the adjacent external water column.

The combined effects of scour from suspended particulates and sediment and food particle supply are particularly important to the development, survival and diversity of cave species populations, especially in caves adjacent to sediment or with sediment floors. The species populations in different sea caves reflect the differing balance between these effects. Information on the sediment transport within the SAC can be found in Appendix 1.

Objective 3: The abundance, distribution and diversity of communities and habitats necessary for the structure and function of the feature are stable or improving, subject to natural variability.

Objective attribute	**Site specific target**
3a. Habitats and communities	Maintain the abundance, distribution and diversity of species within component habitats and communities necessary for the structure and function of the sea caves feature.
3b. Invasive and non-native species	Introduction or spread of new non-native species to the SAC by anthropogenic activities should not have a detrimental impact on the structure and function of the sea caves feature.

Supporting information

3a. Habitats and communities

All the sea cave communities within the SAC contribute to the overall condition of the feature. Changes to the spatial distribution of communities across the feature could highlight changes to the overall feature.

Communities associated with the sea caves feature vary considerably depending on the structure and extent of the caves, the degree to which they are submerged during tidal cycles and their degree of exposure to scour and surge. They are typically colonised by encrusting animal species but may also support shade-tolerant algae near their entrances.

Sea caves in the SAC, though not particularly species-rich in comparison to other sea cave communities in Wales, support assemblages of species such as sponges, sea firs, sea squirts and sea anemones.

Many sea caves in the SAC tend to have floors of coarse sediment, cobbles and boulders, which often scour the cave walls. The most abundant species are those resilient to high

and almost constant turbidity and the effects of sand-scour. As such assemblages of species not often recorded in the rest of the Wales and the UK occur here.

Intertidal sea cave communities are strongly influenced by humidity and air temperature, which in turn, is influenced by air movement. In combination, these conditions in intertidal sea caves tend to favour species sensitive to desiccation. In the larger caves there is zonation vertically (from intertidal through to subtidal areas) and horizontally (from the sunlit entrances through to the shaded and permanently dark rears). More information on the communities of this feature can be found in Appendix 1.

There is currently no monitoring of habitats and communities in the sea caves of the SAC. Therefore this attribute has defaulted to a maintain target for objective 3a. For more information see the latest condition assessment (Hatton-Ellis et al., 2025).

3b. Invasive and non-native species

Non-native species (NNS) may become invasive non-native species (INNS) and displace native species by predating them or out-competing them for food, space or both. This can lead to the loss of indigenous species from certain areas or changes to community structure (JNCC, 2004; Levin et al., 2002), as well as changes to biotope and habitat type. The introduction or spread of NNS within the SAC can occur through various regulated and unregulated pathways. Further information on introduction pathways can be found on the GB non-native species secretariat website.

There is currently no information on INNS present in the sea caves of the SAC. Information on INNS in the SAC as a whole can be seen in Appendix 1.

4. Advice on operations

NRW must provide advice to relevant authorities about operations that may cause,

- deterioration of designated natural habitats
- deterioration of the habitats of designated species
- the disturbance of designated species

This is statutory advice required by regulation 37(3b) of the Habitats Regulations.

This advice is to help relevant authorities direct and prioritise their management of activities that are of greatest threat to the features of the site. The advice given here is without prejudice to any advice provided in relation to the consideration of plans or projects within the meaning of Part 6 of the Habitat Regulations.

Activities operating outside the site may cause pressures that travel into the site. These external pressures may affect features within the SAC.

4.1. Operations which may cause deterioration or disturbance to the features of the site

Table 2 lists activities that have the potential to deteriorate or disturb the designated features of Menai Strait and Conwy Bay SAC and if they are known to occur within the SAC.

This list of operations is not exhaustive. If an operation or activity is not listed in Table 2 it may still have the potential to cause deterioration to the features of the site. Activities occurring outside of the site may still have the potential to impact the features within the SAC. The occurrence information was correct at time of publication, but activities may have ceased or started since. Advice on individual operations should be sought on a case-by-case basis.

Additional information can be found on the Natural England's designated sites website and Marine Scotland's Feature Activity Sensitivity Tool (FEAST). It is important to note that NRW has not agreed sensitivity thresholds with either Natural England or Nature Scot and the information should be used as a general guide. Specific advice on operations should be sought from NRW on a case-by-case basis.

Table 2. Advice on operations for Menai Strait and Conwy Bay SAC.

Operation/Activity	Occurrence in SAC
Dredging: construction and maintenance, including disposal.	Small to medium-scale dock / marina facilities at Conwy, Deganwy, Felinheli, Bangor (Port Penrhyn), Caernarfon. Nearest dredge material disposal sites are in Liverpool Bay. Historic dredge disposal site off Puffin Island but has not been used for many years.
Shipping: Vessel traffic and maintenance (including antifouling).	No data available. Most shipping in transit in the Irish Sea unlikely to pass through SAC, except when the SAC is occasionally used for anchorage by shipping during bad weather.
Shipping: anchoring (commercial).	The SAC is occasionally used for anchorage by shipping during bad weather, or while awaiting dock in Liverpool.
Shipping: Conventional and accidental discharges. (Including ballast water discharge, refuse, sewage, operational, petrochemical, cargo losses and salvage).	Potential exists for a damaged or struggling vessel to be brought in to the Menai Strait SAC. Ballast water convention now in force.
Land claim (gain of land from the sea or coastal wetlands e.g. for agricultural purposes, industrial use and harbour expansions).	No land claim within the SAC although there is some adjacent to the site. See relevant shoreline management plan.
Coast protection: Hard defences (including sea walls, breakwaters, railways and foreshore deposit of rock, rubble etc).	Ongoing flood and coastal erosion protection works. See relevant shoreline management plan.
Coast protection: Soft defences (including saltmarsh restoration, beach replenishment, shingle management etc).	No data available. See relevant shoreline management plan.
Coast protection: Barrages (including storm surge, tidal and amenity).	Not currently present in the SAC.
Artificial reef.	Not currently present in the SAC.

Operation/Activity	Occurrence in SAC
Hard-engineered freshwater watercourses.	No data available. May be present in the SAC.
Power station.	Not currently present in the SAC.
Pipelines.	Gas pipeline beneath Traeth Lafan
Power / communication cables.	Cables run across the central section of Menai Strait.
Effluent disposal by vessels at sea: disposal of sewage, chemical, thermal and sludge dumping. Not CSOs.	NRW and DCWW datasets available on locations and inputs. No thermal or sludge disposal.
Miscellaneous wastes and debris (including refuse and litter).	Litter present in the sea from various sources, including old refuge tip at Morfa Conwy.
Run-off: Agricultural, urban and industrial run-off.	Probably widespread and common around coastal populations and industry. Probably widespread, particularly around coast of Anglesey within SAC, where agricultural use is higher than on the mainland. Concentrated around estuaries.
Fishing: All trawling (Including beam, otter, toothed and any trawled gear).	Occurs on Traeth Lafan sandflat at high tide. Could impact quality of habitat. Light otter trawling from vessels under 12 m occurs in the SAC. Trawling can occur in SAC for University research.
Fishing: All dredging (including toothed, bladed, mechanical, hydraulic and any other great not listed).	Regulated mussel dredging occurs in the Fishery Order located within the over lapping Menai Strait and Conwy Bay SAC, dredging for mussel seed can occur intermittently at a few localised areas adjacent to the SAC.
Fishing: All netting (including gill, tangle, trammel, seine, fyke and any other fishing with netted gear).	Some fixed and drift netting occurs throughout site, but location and intensity information is unknown.

Operation/Activity	Occurrence in SAC
Fishing: All potting (including lobster, crab, prawn and any other fishing with potted gear).	Potting occurs within the SAC, but location and intensity information is unknown.
Fishing: All line fishing (including long-line and handline).	Line fishing occurs within the SAC, but location and intensity information is unknown.
Fishing: All methods of hand gathering (including cockles, Mussels, mussel seed, razor clam, bivalves, winkles, crustaceans, shellfish, algae and plants for human consumption and chemical extraction and biomass (excluding access issues).	Significant regulated commercial cockle fishery on Traeth Lafan, Traeth Melynog and Red Wharf Bay occurs annually, when stocks sufficient, only Traeth Lafan is within the SAC. Also casual private collection. Peeler crab (shore and edible) collection occurs, particularly from boulder shores around the SAC and tyres are used to ‘attract’ ‘peeler’ crabs on the intertidal soft sediment adjacent to the SAC boundary. Hand collection of other species occurs within the SAC but location and effort information is unknown.
Fishing: Bait collection commercial and recreational (including digging, pump, boulder turning etc).	Bait digging occurs within the SAC but location and effort information is unknown. Pump methods target black lug *Arenicola defodiens* on the spring low mark on Red Wharf bay. Boulder turning is widespread and locally intensive for various species of peeler crabs.
Aquaculture: All forms of aquaculture (including algae, sea cages, impoundments, ranching, shellfish ropes and trestles and enclosed recirculation).	Fishery Orders occur within the SAC for mussels. Trestles with oysters in intertidal areas in western Menai Strait. Large recirculation system facility at Penmon adjacent to the SAC.
Water abstraction.	Abstraction occurs at various locations throughout SAC.

Operation/Activity	Occurrence in SAC
Aggregate extraction (including mineral & biogenic sands & gravels).	Not currently occurring in the SAC.
Oil & gas exploration: All oil and gas exploration activity (including seismic survey, drilling and discharges both operational and accidental).	Not currently occurring in the SAC.
Renewable energy generation: All forms of renewable energy (including tidal barrage and impoundments, tidal and wave energy, offshore wind both fixed and floating).	Not currently occurring in the SAC.
Oil spill response: All activities of responding to oil spills at sea and on shore (including chemical, physical and access).	Reactive only. No recent activity.
Recreation: Fishing (e.g. angling and spearfishing).	Occurs within the SAC but location and intensity information is unknown.
Recreation: Boating (e.g. power craft, sailing, canoeing, surfing, kite surfing, paddle boarding, etc).	Occurs within the SAC but location and intensity information is unknown.
Recreation: Coastal activities (e.g. Scuba diving, snorkelling, dog walking, coasteering etc).	Occurs within the SAC but location and intensity information is unknown.
Recreation: Coastal access.	Occurs within the SAC but location and intensity information is unknown. Areas of the foreshore within SAC occasionally have vehicles in relation to launching of boats.
Recreation: Light aircraft.	Small airfield at Caernarfon, light aircraft fly over SAC. Possible drone use.
Recreation: Wildfowling.	Wildfowling occurs on the Foryd and the off shore banks of Traeth Melynog.
Recreation: Marine wildlife watching / eco-tourism.	Bird watching occurs within the SAC but location and intensity information are unknown

Operation/Activity	Occurrence in SAC
Military activity: All forms of military activity (including ordnance ranges, marine exercises, aircraft etc).	No ranges within or near to SAC. Occasional military exercises in Irish sea. RAF Valley airbase on Anglesey. Occasional aircraft transit over SAC.
Marine archaeology & salvage.	No data available. Potential to occur in the SAC.
Science and outreach: Education.	Occurs within the SAC but location and intensity information are unknown.
Science and outreach: Animal welfare operations and sanctuaries.	Occurs within the SAC but location and intensity information are unknown.
Science and outreach: Science research.	Occurs within the SAC but location and intensity information are unknown.

5. Climate change vulnerability

5.1. Climate vulnerability

Marine intertidal habitats are most at risk from climate change. Marine ecosystems will be impacted by climate change through both direct and indirect effects on the distribution and abundance of biotopes and species. Climate change pressures include, rising sea surface temperatures, sea level rise, ocean acidification, air temperature increases, deoxygenation, changes in salinity and increasing wave exposure. There are other pressures that have not been assessed such as those arising from the terrestrial environment for example increased river and sediment run off due to predicted higher rainfall levels.

Climate induced changes could include irreversible impacts to ecosystems from loss of species, degradation of carbon sequestrating habitats (blue carbon habitats) leading to carbon being released and exacerbating the problem.

Below is a climate change profile for each Annex I habitat in the SAC. The profile summarises the climate change pressures each habitat is vulnerable to in this site, excluding sea caves although sea caves are likely to have similar vulnerabilities to both intertidal and subtidal reefs. The summary of impacts for all features can be seen in Table 3.

Table 3. Climate change summary indicating the climate change vulnerabilities for the features of the Menai Strait and Conwy Bay SAC.LSIB = Large shallow Inlets and Bays, MF&SF = Mudflats and sandflats. H = High vulnerability, M = Medium vulnerability, L= low vulnerability, N/V = not vulnerable.

Climate change pressure	MF&SF	Intertidal reefs	Subtidal reefs	Sandbanks	LSIB
Air temperature	M	L	L	N/V	M
Deoxygenation	L	L	L	L	L
Ocean acidification	L	M	M	M	M
Salinity	L	L	L	L	L
Sea level rise	M	L	M	N/V	M
Sea temperature	M	M	L	M	M
Wave exposure	L	H	L	N/V	L

5.2. Coastal squeeze

Extensive work has been carried out (Oaten et al., 2024) regarding the extent to which sea-level rise may cause coastal squeeze and natural squeeze, an issue which affects intertidal habitats. In this SAC, the majority of the losses are due to natural squeeze rather than coastal squeeze because a significant proportion of the coast is natural rather than defended and land often rises quite steeply from the coast causing a natural constraint.

Mudflats and sandflats

The predicted change in the extent of this habitat due to both coastal squeeze and natural squeeze is a loss of 3% (81ha) by 2055, and 20% (615 ha) by 2155 under a RCP 8.5 95th percentile scenario, assuming that defences are managed in line with shoreline management plan policies (Oaten et al., 2024) .

Reefs

The predicted change in the extent of this habitat due to both coastal squeeze and natural squeeze is a short term gain of 6% (24 ha) by 2055, but this becomes a loss of 22% (86 ha) by 2155 under a RCP 8.5 95th percentile scenario, assuming that defences are managed in line with shoreline management plan policies (Oaten et al., 2024) .

6. References

Asghar, A. 1992. Sedimentological, geophysical and oceanographic studies of postglacial and contemporary sedimentary processes of the NE Menai Strait and Conwy Bay (Wales, U.K.). PhD Thesis. School of Ocean Sciences

Best, M. A., Wither, A. W. and Coates, S. 2007. Dissolved oxygen as a physico-chemical supporting element in the Water Framework Directive. *Marine Pollution Bulletin*, 55, 53-64.

Bokn, T.L., Duarte, C.M., Pedersen, M.F., Marba, N., Moy, F.E., Barrón, C., Bjerkeng, B., Borum, J., Christie, H., Engelbert, S., Fotel, F.L., Hoell, E.E., Karez, R., Kersting, K., Kraufvelin, P., Lindblad, C., Olsen, M., Sanderud, K.A., Sommer, U., & Sørensen, K. 2003. The Response of Experimental Rocky Shore Communities to Nutrient Additions. *Ecosystems*, 6(6), 577–594.

Bowers D.G., Al-Barakati A. 1997. Tidal Rectification on Drying Estuarine Sandbanks. *Estuaries* 20: 559-568

Bowers, D. 2005. Marine monitoring project: Menai Strait turbidity and other covariate surveillance. (Interim Report). CCW. Interim Report

Bunker, F.StP.D. and Holt, R.H.F. 2003. Survey of Sea Caves in Welsh Special Areas of Conservation 2000 to 2002. CCW Marine Monitoring Report No: 6, 184pp

Campanella, F. and van der Kooij, J. 2021. Spawning and nursery grounds of forage fish in Welsh and surroundings waters. Cefas Project Report for RSPB, 65 pp.

Coppock, J. 1998. Benthic communities, sediment and acoustic studies in Conwy Bay. M.Sc. Thesis. School of Ocean Sciences

Donnet, S. 2003. Measuring the sediment transport in the Menai Strait using acoustical and optical methods. MSc. Thesis. School of Ocean Sciences.

Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J. 2012. Spawning and nursery grounds of selected fish species in UK waters. Science Series Technical Report, Cefas, Lowestoft, 147: 56pp.

Ellis, J.R., Rogers, S.I. and Freeman, S.M., 2000. Demersal assemblages in the Irish Sea, St George's channel and Bristol channel. *Estuarine, Coastal and Shelf Science*, 51(3), pp.299-315.

Gray, J. and Elliott, M. 2009. *Ecology of Marine Sediments: From Science to Management, Second Edition*, Oxford Biology.

Gihwala, K.N., Frost, N.J., Upson, M.A. 2024. Climate change impacts on Welsh MPAs: Risks to Annex I features and associated blue carbon habitats. Report No: 775. 175pp. Natural Resources Wales, Bangor

Hatton-Ellis, M., Cuthbertson, S., Jackson-Bué, M. and Wynter, E. 2025. Condition Assessments for submerged and partially submerged sea caves in Welsh Special Areas of Conservation. NRW Evidence Report No: 903, 78pp, Natural Resources Wales, Cardiff.

Jackson, S.E., Bowers, D.G. and Harris, M. 2022. The effect of aggregation/disaggregation on suspended particulate matter transport in a tidal strait. *Continental Shelf Research*, 245, p.104787.

Jackson-Bué, M., Wynter, E., Brazier, D.P., Cuthbertson, S. and Hatton-Ellis, M. 2025a. Condition Assessments for Mudflats and Sandflats not Covered by Seawater at Low Tide in Welsh Special Areas of Conservation. NRW Evidence Report No: 898, 121pp, Natural Resources Wales, Cardiff.

Jackson-Bué, M., Wynter, E., Camplin, M., Goudge, H., Brazier, D.P., Cuthbertson, S. and Hatton-Ellis, M. 2025b. Condition Assessments for Reefs in Welsh Special Areas of Conservation. NRW Evidence Report No. 900, 135pp, Natural Resources Wales, Cardiff

Jackson-Bué, M., Wynter, E., Cuthbertson, S. and Hatton-Ellis, M. 2025c. Condition Assessments for Large Shallow Inlets and Bays in Welsh Special Areas of Conservation. NRW Evidence Report No. 897, 106pp, Natural Resources Wales, Cardiff.

Jackson-Bué, M., Wynter, E., Cuthbertson, E., Jones, S. and Hatton-Ellis, M. 2025d. Condition Assessments for Sandbanks which are slightly covered by seawater all the time in Welsh Special Areas of Conservation. NRW Evidence Report No: 902, 81pp, Natural Resources Wales, Cardiff.

Jafar Sidik, M. (2016) Optical Measurements of Suspended Sediments. PhD. Bangor University.

JNCC. 2004. Marine Advice: Non-Native Species [Online]. (Accessed 18/03/2024).

Kaiser, M.J., Bergmann, M., Hinz, H., Galanidi, M., Shucksmith, R., Rees, E.I.S., Darbyshire, T. & Ramsay, K. 2004. Demersal fish and epifauna associated with sandbank habitats. *Estuarine, Coastal and Shelf Science*, 60, p.p. 445–456.

Kratzer S., Bowers D., Tett P.B. 2000. Seasonal changes in colour ratios and optically active constituents in the optical Case-2 waters of the Menai Strait, North Wales. *International Journal of Remote Sensing*,21: 2225-2246

Kratzer, S., Buchan, S. & Bowers, D.G. 2003. Testing long-term trends in turbidity in the Menai Strait, North Wales. *Estuarine, Coastal and Shelf Science,* 56: 221-226

Levin, P.S., Coyer, J.A., Petrik, R and Good, T.P. 2002. community-wide effects of nonindigenous species on temperate rocky reefs. *Ecology*, 83(11): 3182-3193.

Mainwaring, K., Tillin, H., and Tyler-Walters, H. 2014. Assessing the sensitivity of blue mussels (*Mytilus edulis*) to pressures associated with human activities. JNCC Report No: 506. JNCC, Peterborough.

Morris, E.S. and Goudge, H. 2006. Literature review and bibliography of the biotic and abiotic characteristics of the maritime environment of the Menai Strait and Conwy Bay area. CCW Policy Research Report No. 06/3. Pp252.

Oaten J, Finch D, Frost N. 2024. Understanding the likely scale of deterioration of Marine Protected Area features due to coastal squeeze: Volume 2 – Results & Discussion. NRW Evidence Report No: 789, 112pp, Natural Resources Wales, Bangor

OSPAR Commission. 2012. Co-ordinated Environmental Monitoring Programme (CEMP) 2011 Assessment Report.: OSPAR.

Rippeth, T.P., Williams, E., Simpson, J.H. 2002. Reynolds stress and turbulent energy production in a tidal channel. *Journal of Physical Oceanography*. 32, 1242–1251.

Simpson, J.H., Forbes, A.M.G., Gould, W.J. 1971. Electromagnetic observations of water flow in the Menai Straits. *Geophysical Journal International*, 24, 245–253.

Smale, D.A., Burrows, M.T., Moore, P., O'Connor, J. and Hawkins, S.J. 2013. Threats and knowledge gaps for ecosystem services provided by kelp forests: a northeast Atlantic perspective. *Ecology and Evolution*, 3 (11), 4016-4038.

Smyth D, Hayden-Hughes M, Ward S, Winterbourn B, Malham S and Le Vay L. 2022. Current status of the Pacific oyster, *Crassostrea (Magallana) gigas*, in the Menai Strait, spawning potential and potential mitigation using triploid oysters. Unpublished report. Bangor University, The Shellfish Centre.

Worm, B. and Lotze, H.K. 2006. Effects of eutrophication, grazing and algal blooms on rocky shores. *Limnology and Oceanography*, 51 (1), 569-579.

Young, G.A. 1993. The Menai Strait: A review and bibliography of literature from the Wolfson library. University College of North Wales, Wolfson Library

Appendix 1: Additional information

SAC Description

The Menai Strait and Conwy Bay SAC features range across both the sub and inter tidal. In places the landward boundary abuts the boundary of SACs encompassing terrestrial / coastal habitats and species and some intertidal areas that are part of the marine SAC have been notified as sites of special scientific interest (SSSI). The SAC also overlaps wholly or in part several special protection areas (SPAs) classified under the Birds Directive. See appendix 2 for details. When the SAC boundary was drawn up, the biological survey and assessment of most of the foreshores within North Wales had not been completed and therefore many ecologically important intertidal areas are not included in the SAC. Of note are the intertidal parts of the sea caves and reefs around the Great and Little Ormes, intertidal mudflats and sandflats, and much of the foreshore on the north and south side of the Menai Strait.

Geology

Geology within the SAC is complex and varied. There is hard green schist and gneiss in the central region of the Menai Strait, and exposures of softer carboniferous limestone around the north-east coast of Anglesey, the Great and Little Ormes, in the Menai Strait along the south shore of the Swellies and the north shore at Plas Newydd. There are likely to be additional exposures of carboniferous limestone within the central Menai Strait, but further survey work would be required to verify this. Many rocky areas within the SAC are composed of boulders, cobbles and pebbles rather than bedrock. Throughout the site, geological features such as folding, fracturing, faulting and erosion provide a varied rock topography which increases habitat diversity by forming crevices, gullies, fissures and overhangs in the rock. These physical characteristics, together with factors such as the sediment transport, salinity regime and water quality in turn influence the assemblages of marine species associated with the different reef habitats throughout the SAC.

Sedimentology

The sediment of the Menai Strait predominantly originates from the Quaternary period, together with sediment left by retreating glaciers and those washed off the land by rivers and streams (Young, 1993). The seabed in the main channel at the northern end of the Menai Strait is largely composed of medium to coarse shell fragments and the intertidal areas are mostly sands with localised mixtures of gravel and mud. The sandflats, including those at Traeth Lafan, are medium and fine sands, although there is a greater proportion of mud towards the upper intertidal resulting from the reduced wave action and tidal streams (Asghar, 1992). At Menai Bridge, strong currents mean the mid-strait region is composed of rocks and stones with very little sediment accumulation except in sheltered embayments. South of the Swellies the strait gradually widens towards the bank of predominantly fine sands called Traeth Gwyllt opposite Tal-y-Foel pier. Clay and silt is found in regions of low energy, such as Foel Jetty and the eddy created by Trefarthen Point, as well as around the area at Afon Seiont, Caernarfon. Medium sand occurs in regions of higher energy in the central channel. Further south at Traeth Melynog and also at Braich Abermenai, the sediment is characteristically uniform fine sand, except for the main channel where, in some places, the sediment is composed of gravel and pebbles.

Foryd Bay, on the south side of the strait, has larger than expected sediment particle size due to the stable, sheltered nature of the beach, which consists of coarse gravels lying beneath a layer of muddy sand. Only the lower shore here is destabilised by the strong tidal currents of the Menai Strait.

Generally, the seabed in Conwy Bay is gently shelving, with depths of less than 30m (most are less than 20m). The sediments in Red Wharf Bay and Conwy Bay range from gravels covered with sand veneers, areas of sand waves and sand ribbons, shell fragments to fully developed sand banks with organically enriched muddy patches (Rees, 2004). Overall, in Conwy Bay there is a trend of more muddy sediments close to land. Areas of mixed sediments occur around the Great Orme and south of Puffin Island (Coppock, 1998). West of the Great Orme there is an area of fine sediments, suggesting a sheltered area of deposition and low energy (Coppock, 1998).

Geomorphology

The varied geology, geological processes and physical environmental conditions experienced throughout the SAC have resulted in a combination of complex coastal and marine morphological features. Physical processes such as wind and wave action have shaped, and continue to shape, the areas of hard substrate. Particularly the pebble, cobble and boulder areas within the SAC. Glacial and post-glacial Irish Sea sediments throughout the SAC have undergone extensive reworking by the action of wind, waves and tidal currents, resulting in the formation of large tidal deltas at both ends of the strait (Solangi, 1992).

The two rocky headlands of Point Lynas and the Great Orme deflect the tidal current running to and from the inner parts of Liverpool Bay and the shelter provided to Conwy Bay results in muddy sediment deposits in this area. At the north-eastern end of the Menai Strait by Gallows Point, south-west of Beaumaris, the depth varies over short distances. During low spring tides a sand ridge can be exposed by up to 3 m, whilst only 450 m south of Gallows Point there is a hole with a depth of 22-26 m below chart datum. This is commonly referred to as ‘Gallows Deep’ and comprises a cliff with clay outcrops and a cobble and shell fragmented bottom. Water depths in the central Menai Strait channel vary from a few metres to nearly 22 m, whilst the average depth of the strait itself is approximately 10m. Undersea cliffs on the southern shore of the strait extend under the Menai Suspension Bridge and into an area of shallow tidal rapids between the two bridges, known as the Swellies. South of this the strait channel reaches 27m at its deepest point, at Pwll Fanogl, which is believed by some to be a pothole in the underlying limestone.

Red Wharf Bay is a shallow bay comprised mostly of intertidal soft sediments. Depths range from 5 – 8 m and there is only one navigable channel at Trwyn Dwlban, through the intertidal mud and sandflats. The channel gets deeper where a small river, Afon Nodwydd, joins two smaller tributaries on the western side of the bay. Further offshore is the Four Fathom Bank, which is generally shallower than 10m. From the east edge of Red Wharf Bay to Penmon Point runs the Table Road channel, an area close to the North Anglesey coast with a depth ranging from 10 -16 m. Puffin Island Sound, between Red Wharf Bay and Conwy Bay includes a narrow submarine channel with a maximum depth of 16 m. To the north of Puffin Island another interesting feature is Turbot Hole, a steep sided hole reaching a maximum depth of 24 m.

Conwy Bay is gently sloping, mostly around 20 m but with occasional areas up to 30 m in depth. The outer edges of the Conwy estuary are muddy, with sandbank islands in the

central channel exposed at low tide and broken by smaller channels. At the north-east entrance to the Menai Strait there are extensive intertidal sandbanks and mudflats, most notably, Bangor Flats and Traeth Lafan. Further offshore the Dutchman's Bank is only partially exposed at extreme low tides. Within Conwy Bay itself, mega ripples (ripples with a wave length of between 5 and 15 m) have been recorded at depths of 9 m and 11 m.

Hydrography

The hydrodynamic regime in the Menai Strait and Conwy Bay varies significantly over time and geographically, it is the variation in tidal current velocity, tidal height and turbidity that provides a range of habitats which in turn influences the assemblages of marine species throughout the SAC (Morris and Goudge, 2006). Currents and tides are complicated in the Menai Strait, with opposing inflows at the southwestern and north-eastern ends meeting between Bangor Pier and the Swellies. When this occurs there is no horizontal flow of water for about half an hour, although the water level continues to rise. Eventually all the water begins to flow to the south-west and then close to low water, the last of the tide in the north-east changes direction and flows back to the north-east past Beaumaris. The mean tidal range in the Menai Strait increases from approximately 4 m at Fort Belan at the southwestern end to approximately 6 - 7 m at Beaumaris in the north-east. This difference leads to a residual flow of approximately 0.15 ms^{-1} to the southwest through the strait (Simpson et al., 1971; Rippeth et al., 2002).

Water and suspended material entering the north-eastern end of the strait may take two to three days or more than a week, to reach the south-western end with the prevailing south-westerly flowing tide. On a spring tide, water and suspended material can enter and pass through the entire length of the Menai Strait in one tidal cycle. Tidal flows reach 3.5 to 4 m/sec in the Swellies and in the narrows near Caernarfon, and around 2.5 m/sec in Penmon Sound. Elsewhere in the strait they mostly do not exceed 1.5 or 2 m/sec and there are regions where the current is significantly less. There are many tidal eddies and gyres throughout the Menai Strait and, some at Gallows Point and Puffin Island. The rocky headlands of Point Lynas and the Great Orme deflect the tidal current running to and from the inner parts of Liverpool Bay, so that tidal currents in the outer part of Conwy Bay are generally slight (0.3 – 0.45 m/sec). Elsewhere in Conwy Bay and around the Great and Little Ormes, tidal streams run at less than 1 m/sec. Residual currents near Great Orme's Head are to the north-east. In the Conwy Estuary, weak flood-directed currents occur on drying sandflats, but much stronger ebb-directed currents occur in the channels on either side. The whole of the Menai Strait is wave-sheltered and Conwy Bay facing north-north-east is sheltered from the prevailing westerly to south-westerly winds and the longer open sea swells which can impinge on the western side of Anglesey.

Sediment transport

Most of the sediment transport in the Menai Strait is as suspended material in the water column. In the main channel of the Menai Strait and north-east of Puffin Island water movement may also transport larger or coarser particles along the seabed.

Suspended material in the Menai Strait is dominated by muddy sediments (mainly clay) joined together with organic material (Kratzer et al., 2000). Turbidity, the total concentration of suspended material, varies with time, with seasonal and fortnightly periodicity (Kratzer et al., 2000). The fortnightly cycle is driven by greater mixing by spring tidal currents giving rise to enhanced turbidity values. Seasonally, enhanced mixing caused by wind and storm waves in winter gives rise to the maximum values in turbidity

(Kratzer et al., 2000). Data collected over one spring tidal cycle, as storm conditions progressed, report that suspended sediment concentrations range from 4 - 11 mg/l by Menai Bridge (Jackson et al., 2022). Long-term datasets in the Menai Strait show increasing turbidity in the 1960s, 1970s and 1980s but a similar proportion of mineral to organic fractions, indicating the fluctuating trend was probably due to changes in wind activity over the period (Morris and Goudge, 2006). In the mid-1990s, mineral suspended solid and total suspended solid concentrations in the strait had almost returned to the values recorded in the 1960s (4.78 mg/L and 6.34 mg/L respectively). Elsewhere within the SAC, turbidity and suspended sediments have not been monitored as rigorously as in the Menai Strait. However, it has been noted that the water in Conwy Bay, is generally less turbid than in the Menai Strait and water in the Conwy Estuary becomes less turbid with increased distance from land (Kratzer et al., 2003).

The net direction of sediment transport through the Menai Strait is in the same direction as the prevailing water flow, towards the south-west. During a tidal cycle, an estimated 15 tonnes of sediment may be transported through the Menai Strait to the south-west (Donnet, 2003).

Offshore sediments at the north-eastern end of the Menai Strait are thought to be transported shoreward and south-west by intermittent suspension caused by residual currents and by wave action (Asghar, 1992). In the Conwy Estuary, currents across drying sandbanks are largest at the mouth of the estuary potentially moving the tips of the sandbanks upstream (Bowers and Al-Barakati, 1997).

Water chemistry (physicochemical properties)

The River Conwy is the largest of all the rivers that discharge into the SAC. Two major rivers also enter the SAC at the north-east and south-western ends of the Menai Strait (the Ogwen and the Seiont). The volume of water discharged from rivers is relatively small and the salinity of the Menai Strait is generally between 32 ‰ and 34 ‰, only infrequently dropping below 30 ‰. Salinity in Conwy Bay is approximately 33 ‰ and is predominantly controlled by marine waters rather than riverine inputs except near to the mouth of the estuary.

The waters of the whole SAC are relatively turbid. The temporal pattern of total SPM in 2014 showed seasonal variation; higher values in winter compared to summer. The mean SPM concentration in winter (N=37) was 13.9 mg l^{-1} and in summer (N=41) 8.6 mg l^{-1} (Jafar Sidik, 2016). These relatively high levels of suspended material reflect the species and communities present. High levels of suspended material provide favourable conditions for animals which feed by filtering or capturing their food from the water column. Highly turbid water also reduces the levels of light that can penetrate the water column, which limits the water depth to which seaweeds within the SAC can survive, since photosynthesis is restricted.

The surface temperature of the Menai Strait generally varies seasonally between 4 and 17ºC. Surface temperature reaches a maximum between July and August and a minimum between January and March. In Conwy Bay measurements taken irregularly between January 2004 and December 2005 showed an average annual water temperature of 11.9ºC. An NRW subtidal logger showed an increase in temperature in more recent years. An report by Bangor university looked at daily mean temperatures in the Menai strait between 2011- 2019 and found that the annual mean sea surface temperature was

gradually rising (Smyth et al., 2022), consistent with the effects of climate change. Though no impacts on features from increased temperatures have been observed.

Species

The variety of rock types and their complex formations present throughout the SAC provide many different types of substrate for colonisation by different species of marine plants and animals. This includes species which live on the surface of the rock such as seaweeds, barnacles, sponges and soft corals, and infaunal species that are able to bore into the surface of the rock, including piddocks, rockboring sponges and acorn worms. Cobble and boulder areas provide under-cover shelter, as well as space between the rocks for more delicate species that are not able to survive on open rock surfaces. Areas of rock with fissures, cracks and crevices provide habitat for shade-tolerant species. The waters of the whole SAC are relatively turbid which limits the water depth to which seaweeds within the SAC can survive. Sediment type has a strong influence over the types of marine species which are associated with intertidal and subtidal sediment areas within the SAC. The surface of the sediment is often apparently devoid of vegetation, although mats and films of micro-algae are common. Muddy areas are highly productive, containing high levels of organic material and so are very important to the marine ecosystem, playing an important role in marine food chains. They generally support very large numbers of individuals of a few species. Few rare species occur in these areas. Diversity of various species, including marine worms tends to increase with increasing levels of sand and gravels, particularly where conditions result in sediments being muddier. However, in areas of coarse sand, where the sediment is of similar grain size, the sediment is easily moved by waves and tides and only a few specialist species are able to exist in these areas.

Tidal streams play a very important role in structuring the habitats features of the SAC and their associated species assemblages, particularly in the Menai Strait, which is one of the largest tidal rapid systems in the UK. Strong tidal streams result in characteristic communities, dominated by filter feeding animals fixed onto or into the seabed or growing on seaweeds, typically including soft corals, hydroids (sea firs), bryozoans (sea mats), large sponges, sea anemones and mussels. The fast-flowing water brings a good supply of food and nutrients, supporting the growth of these animals and, in many areas of the strait, sponges can grow to unusually large sizes. In areas of extremely strong tidal currents, species are restricted to those that grow as thin encrusting layers across the seabed, since anything larger would quickly get swept away. The lack of strong wave-action within much of the SAC results in the rocky shores being dominated by seaweeds like the serrated wrack *Fucus serratus* and kelps such as oar weed *Laminaria digitata*. Areas within the SAC which are exposed to moderate wave-action, such as the north Penmon coast are dominated by a mixture of seaweed, mussels and barnacles, which are resistant to dislodgement by waves. Waves can also influence the size and shape of animals and plants. For example, mussels found on rock habitats in sheltered areas within the Strait are much larger than those on the north Penmon coast because they can open their shells and feed more frequently in the more sheltered conditions. Increases in water temperature due to climate change may have a greater effect on the marine plants and animals within areas like north Wales than other parts of the UK, since many southern species reach their northern range and many northern species reach their southern range limit here. Consequently, increases in mean annual water temperature will result in changes (and have already in some cases) to the distribution of many plants and animals in this area.

Invasive non-native species

The high-risk invasive non-native species (INNS) that have been recorded within the SAC include the slipper limpet *Crepidula fornicata* in various locations in the western end of the Menai Strait, the Chinese mitten crab *Eriocheir sinensis with* one record in 2010 but live sightings in 2024 in Deganwy just outside the SAC, and the Pacific oyster *Magallana gigas* mainly around Brynsiencyn. Occurrence records can be found on the Wales INNS portal.

There is also a small but stable population of Chilean oyster *Ostrea chilensis*, located around the Western Menai Strait near Brynsiencyn. This is perceived to be a low-risk species.

High impact INNS that pose a risk to the site, but are not currently recorded in the site, are the carpet sea squirt *Didemnum vexillum* and American jack knife clam *Ensis leei* (Tillin and Pegg, in draft). The rapa whelk *Rapana venosa* has not been recorded in the UK to date, but is noted as a potential predator of shellfish, especially mussels, which has the potential to impact this site (Tillin et al., 2020).

Additional information for features of the site

General feature descriptions and ecological characteristics can be found on the JNCC habitats list and species list. Habitat definitions can be found in the European Union Interpretation Manual of Annex I habitats.

Mudflats and sandflats not covered by seawater at low tide

A variety of species assemblages are associated with mudflat and sandflat communities, including those living within the sediment, those living on the surface of the sediment, and mobile species. These communities include some unusual or nationally restricted examples, as well as highly representative examples of some of the nationally common types. Collectively they are of interest for their species richness and for being typical of the tide swept, predominantly wave-sheltered and turbid conditions that prevail throughout the SAC.

Intertidal muddy gravels

Muddy gravel communities are characterised by a mixture of mud and sandy mud with gravel and pebbles in patches. In many locations, the rich muddy gravel habitat is overlain by thick growths of serrated wrack *Fucus serratus*, attached to larger cobbles and pebbles. The infaunal communities associated with muddy gravel habitats in the Menai Strait are very diverse and highly productive, with over 180 animals in 0.25 m^3 recorded in some areas. Compared to similar habitat elsewhere in Wales there is also an unusually high diversity and abundance of marine worms. Deposit-feeding species such as the lugworm *Arenicola marina*, spaghetti worms (terebellids) and syllid worms are abundant in these muddy gravel habitats, as are detritus feeders such as the capitellid worm *Mediomastus fragilis*. Suspension feeders such as the sand mason worm *Lanice conchilega* and the peacock worm *Sabella pavonina* are also common. As are mobile carnivorous species, such as bootlace worms (nemerteans), the king ragworm *Neanthes virens* and the ragworm *Hediste diversicolor*. Other animals found in these species-rich habitats include amphipod shrimps, small shore crab *Carcinus maenas*, common shrimp *Crangon crangon*, brittlestars *Acrocnida brachiata*, sea mats (bryozoans) *Electra pilosa* and bivalves such as

carpet shells *Venerupis corrugata*, cockles *Cerastoderma edul*e and blue mussels *Mytilus edulis*.

The smaller patches of muddy gravels on the extreme lower shore between Menai Bridge and Gallows Point at Beaumaris tend to be muddier and support an infaunal community consisting of burrowing anemones, such as the fried egg anemone *Sagartia elegans*, the daisy anemone *Cereus pedunculatus* and the dahlia anemone *Urticina felina*, as well as various bristle worms (polychaetes and oligochaetes), bivalves and crustaceans.

Intertidal sediments at Traeth Lafan

Traeth Lafan has both muddy and sandy sediments that experience a broad range of wave exposure. There is vertical zonation of the marine communities from the top to the bottom of the shore, reflecting differing tolerances to uncovering by the tide and desiccation. There is also zonation from east to west across the shore, as wave exposure decreases and the mud content of the sediment increases. Some areas of Traeth Lafan also experience variable salinity due to the presence of the rivers Ogwen, Ddu and Aber. The lower shore sediment is mainly clean, mobile sands and gravels supporting bristle worms, shrimps and bivalves. The extreme lower shore can be very coarse sand and shell gravel with a sparse infauna of bristle worms including the catworm *Nephtys* sp. and amphipod shrimps, whilst the sand mason worm *Lanice conchilega* is found in more tideswept areas. In areas along the lower shore where there is less shell gravel, abundant surf clam *Spisula solida* and other bivalves such as the clam, *Chamelea gallina* and the thin tellin *Angulus tenuis* may occur. Areas of mobile lower shore sand supports slabber shrimps *Parahaustorius holmesi* and sand digger shrimps *Bathyporeia* spp.

Within parts of the intertidal mudflats and sandflats feature on Traeth Lafan there is a large seabed lay mussel fishery. The Fishery Order was in place when the SAC was designated, and the habitat was highlighted as ‘modified’ from the time of designation. CCW (now NRW) stated that this habitat modification was accepted, and restoration of these areas of intertidal mudflat and sandflat would not be sought. Since then, the scale and extent of the fishery has not significantly increased.

Reefs

An important characteristic of the communities associated with the reefs feature is their ecological variation which is a reflection of the changing conditions and geology throughout the site. Communities in the ‘Swellies’, in the central section of the Menai Strait reflect the extremely tide-swept conditions here. In the more open waters of Conwy Bay and around parts of the Great and Little Ormes, communities are more typical of those in more moderately wave-exposed conditions. These communities include some unusual or nationally restricted examples, as well as highly representative examples of some of the nationally common types. Collectively these are of local interest for their high species richness, extent, and for being typical of the tide-swept and turbid conditions that prevail throughout the SAC.

All the reef habitats and communities of the feature contribute to the overall representation, range and integrity of the feature within the SAC. The following are notable reef habitats and their associated assemblages of marine plants

Reef communities in high energy wave-sheltered, tide-swept conditions

The Menai Strait contains some of the best examples of strongly tide-swept reef in the UK.

Species associated with tide-swept reef include the breadcrumb sponge *Halichondria* spp., shredded carrot sponge *Amphilectus furcorum*, hornwrack *Flustra foliacea*, encrusting and turf forming sea mats (bryozoans) composed of species such as *Scrupocellaria scruposa* and sea chervil *Alcyonidium diaphanum*, and sea squirts such as the star ascidian *Botryllus schlosseri* and the baked bean sea squirt *Dendrodoa grossularia*. A variety of mobile invertebrates, including crabs, starfish, brittlestars and various species of marine worm are also associated with these communities.

Strong tidal currents experienced in these reef areas prevent many grazing animals, such as periwinkles and topshells, from accessing open rocky surfaces. As a result, in the intertidal and shallow subtidal, where light levels are high enough, dense foliose red seaweeds flourish, including species such as dulse *Palmaria palmata*, false Irish moss *Mastocarpus stellatus*, *Hildenbrandia rubra* and species of encrusting coralline algae such as *Lithothamnion* sp. In particularly highly tide-swept areas, where sand is suspended in the water, robust tough red seaweeds such *Polyides rotundus*, *Ahnfeltia plicata* and carrageen *Chondrus crispus* occur. In many locations in the strait, intertidal and shallow sublittoral tide-swept reefs are often overlain by very dense coverings of brown algae such as serrated wrack *Fucus serratus*, egg wrack *Ascophyllum nodosum* and oar weed *Laminaria digitata*. Large seaweeds such as these are heavily colonised by colonial seasquirts and sea mats such as *Flustrellidra hispida* and *Alcyonidium gelatinosum*. Around Church Island, egg wrack *Ascophyllum* noIdosum is colonised by the club-headed hydroid *Clava multicornis*. Red seaweeds such as *Phycodrys rubens*, *Plocamium cartilagineum* and sea beech *Delesseria sanguinea* grow as epiphytes on the kelp and wrack plants. Tideswept communities are present on the ‘goradau’, medieval and post medieval fish traps composed of boulders, that are mostly found along the Anglesey side of the Menai strait between Beaumaris and Penmon point.

Subtidally, due to the turbid conditions in the site seaweed cover is restricted and filter-feeding animals dominate hard areas of the seabed. In areas of moderate tidal stream, communities are composed of unusually large and abundant sponges. Single colonies of the breadcrumb sponges *Halichondria panicea* and *Halichondria bowerbanki* can cover areas of over 1 m^2, whilst the finger sponge *Haliclona oculata* also grows to unusually large sizes. Surveys have shown however, that the abundance of sponges in the Menai Strait is decreasing. Investigations into the reasons why this may be the case have begun. These sponges themselves provide a habitat for colonisation by a wide variety of marine invertebrates, including the oaten pipes hydroid *Tubularia indivisa*, the sea fir *Sertularia argentea* and sea anemones including the fried egg anemone *Sagartia elegans*, the plumose anemone *Metridium dianthus* and the dahlia anemone *Urticina felina*. Many mobile species are associated with these subtidal reef areas, including the velvet swimming crab *Necora puber*, shore crab *Carcinus maenas*, edible crab *Cancer pagurus*, the long-clawed porcelain crab *Pisidia longicornis,* the butterfish *Pholis gunnellus,* and various wrasse species (*Labridae* spp.) which live and feed on the reefs.

In extremely tide-swept locations such as the Swellies, the current is too strong for most erect species like sponges to survive and only acorn barnacles *Balanus crenatus* and thin encrusting sponges can maintain their position on intertidal and subtidal boulders and bedrock.

Under-boulder, overhang and crevice communities

The communities associated with intertidal underboulder habitats in the Menai Strait are particularly diverse, as a result of the highly turbid, tide-swept conditions. The upper surfaces of boulders are dominated by either serrated wrack *Fucus serratus* on the mid to lower shore and oar weed *Laminaria digitata* on the extreme lower shore, often heavily colonised by colonial seasquirts and sea mats. The shaded sides of boulders are often colonised by various foliose and filamentous red seaweed species, such as false Irish moss *Mastocarpus stellatus*, *Lomentaria articulata*, pepper dulse *Osmundea pinnatifida*, dulse *Palmaria palmata* and carrageen *Chondrus crispus*.

The animal communities on the undersides of boulders may vary considerably depending on the type of underlying substrate. On muddy shores, the boulders sink into the surface of the mud, so that their undersides have a relatively sparse associated fauna. On firmer surfaces diverse and nationally uncommon communities can occur that are dominated by sponges including the shredded carrot sponge *Amphilectus fucorum*, *Leucosolenia* sp., *Hymeniacidon perleve* and the breadcrumb sponge *Halichondria panicea*. These sponge dominated communities also have a rich associated assemblage of animals which form turfs and colonies. This is particularly the case in tide-swept areas, where encrusting species such as sea mats (bryozoans) *Electra pilosa* and *Oshurkovia littoralis*, solitary and colonial sea squirts such as the baked bean sea squirt *Dendrodoa grossularia*, the star ascidian *Botryllus schlosseri*, and sea firs such as *Obelia* spp. occur. Other animals such as sea anemones *Sagartia troglodytes*, keel worms *Spirobranchus triqueter*, various spirorbid worms and saddle oysters *Anomia ephippium* also thrive in this habitat. Characteristic mobile species associated with these habitats include gastropods such as the flat periwinkles *Littorina obtusata* and *Littorina mariae*, the common periwinkle *Littorina littorea*, and the grey topshell *Gibbula cineraria*, as well as decapods such as the broad-clawed porcelain crab *Porcellana platycheles*, the long-clawed porcelain crab *Pisidia longicornis* and juvenile edible crabs *Cancer pagurus* and fish such as the butterfish *Pholis gunnellus,* the shanny *Lipophrys pholis,* and various wrasse species (*Labridae* spp.) which live and feed on the reefs.

Subtidally, where boulders and cobbles occur, animal communities of sea anemones, including the dahlia anemone *Urticina felina* and *Sagartia troglodytes*, as well as a variety of different sea mats and turf forming sea firs develop.

The Great and Little Ormes are more wave-exposed and less tide-swept than elsewhere in the SAC. Less extensive seaweed growth occurs here than in the more wave-sheltered Menai Strait. On the upper surfaces of boulders, beneath the wrack or kelp canopy, species such as the common limpet *Patella vulgata*, the dogwhelk *Nucella lapillus*, the beadlet anemone *Actinia equina* and the acorn barnacle *Semibalanus balanoides* occur.

The rock topography around the north-east coast of Anglesey and the Great and Little Ormes results in the formation of crevices, gullies, fissures and overhangs in the rock, which increases the diversity of habitat types. Crevice and overhang habitats are inhabited by shade-tolerant species of red seaweed such as *Lomentaria articulata*, *Plumaria plumosa* and *Membranoptera alata*. Shaded walls and overhangs are also covered by animal turfs and crusts, consisting of barnacles, sponges, sea mats, sea firs, sea squirts, calcareous tube-worms such as *Spirorbis* spp. and keel worms *Spirobranchus triqueter*. Anemones such as the beadlet anemone *Actinia equina* may often be found in particularly damp crevices and overhangs.

Limestone reef communities

Unique intertidal and subtidal reef communities are associated with the carboniferous limestone habitats around the northeast coast of Anglesey, including offshore islands and around the Great and Little Ormes. In addition to species generally associated with other rock types throughout the SAC, limestone areas also provide a habitat for species that can bore into the surface of the soft rock. Intertidally these include large numbers of the wrinkled rock borer *Hiatella arctica*, and piddocks (exact species unknown), whilst subtidally the rock-boring sponge *Cliona celata*, boring worms *Polydora* spp. and acorn worms *Phoronis hippocrepia* can be found. These are typically found along the lower shore where serrated wrack and oarweed are present. In some intertidal areas the surface of the rock is dominated by the muddy tubes of boring worms *Polydora* spp..

Clay outcrop reef communities

An unusual subtidal reef community, composed of boring bivalves such as wrinkled rock borer *Hiatella arctica* is associated with clay outcrops occurs in two known locations in the eastern Menai Strait, near Gallows Point just west of Beaumaris and between Beaumaris and Penmon.

Blue Mussel *Mytilus edulis* beds

The blue mussel *Mytilus edulis* is a suspension feeding bivalve that can be found from the strand-line down to the sublittoral. Blue mussels can often form dense beds with multiple layers; sometimes forming the basis of a biogenic reef. These beds stabilise sediment and provide a habitat for many infaunal and epifaunal species, with biodiversity increasing with the size and age of the bed (Mainwaring et al., 2014). There is some evidence to suggest that beds of the horse mussel *Modiolus modiolus* occurred north-east of Puffin Island in the past, but these are no longer thought to be present, with only empty shells being found on recent surveys.

Kelp beds

Kelp refers to a range of large brown seaweeds that grow from the lower intertidal to the subtidal. Depth is dependent on light availability in the water column. Kelp beds are extremely productive and biodiverse environments. They provide shelter and food for hundreds of species as well as playing an important role in nutrient cycling and carbon sequestration (Smale *et al.*, 2013). Kelp occurs in a relatively narrow band on most rocky substrate throughout the SAC.

Honeycomb worm *Sabellaria alveolata* reef

The Honeycomb worm, *Sabellaria alveolata*, is a gregarious polychaete worm that builds tubes from sand or shell fragments on hard substrata. Found mainly in exposed intertidal areas *Sabellaria* are often densely aggregated and can form large reefs and take the form of hummocks, sheets or more massive formations (UK BAP, 2008). These reefs provide important habitat for a range of epibenthic and fish species, becoming biodiversity hotspots.

Records of *Sabellaria* reef have been noted around Trywn y Penrhyn (near Aberlleiniog in the eastern Menai Strait), but these have not been mapped. It has also been noted on the western side of the Great Orme near Deganwy West Shore, but it is unclear whether this extends into the SAC.

Estuarine rocky habitats

Estuarine rocky habitats are found in areas of low and variable salinity. Within Wales, these habitats are restricted due to the majority of our estuarine areas being sediment dominated.

Small patches of estuarine rocky habitats are found on cobbles and boulders within Foryd Bay and at the mouth of the River Ogwen. These are colonised by brown seaweeds associated with sheltered conditions such as channel wrack, spiralled wrack and egg wrack. The low salinity brown seaweed horned wrack is also present.

Large shallow inlets and bays

Communities

A variety of communities and species are associated with the large shallow inlets and bays (LSIB) feature, many of which are associated with the other four Annex I habitat features. Long-term studies of the species and communities associated with subtidal sediments within the large shallow bay appear to show a tendency towards increasing stability in community structure.

The biomass of species and communities in areas of enriched muddy sand is higher than on the adjacent more tide-swept sands and gravelly sands. These areas are dominated by deposit-feeders such as the tube-dwelling trumpet worm *Lagis koreni*, the razor shell *Pharus legumen*, the blunt gaper *Mya truncata*, *Abra alba*, *Nucula nitidosa* and the basket shell *Corbula gibba*. Mobile species such as the common starfish *Asterias rubens*, the sandstar *Astropecten irregularis*, brittlestars *Ophiura ophiura*, *Amphiura filiformis*, sea potatoes *Echinocardium cordatum* and common whelk *Buccinum undatum* are also associated with these areas. Many of these species are opportunistic, with short life spans and high production rates, therefore, the fauna of the inshore muddy sands are liable to be quite variable from year to year.

Red Wharf Bay and Conwy Bay are known to be nursery, feeding and possibly spawning areas for a variety of fish species, some of which may be recruited into the Irish Sea fisheries. The shallower waters of Liverpool Bay adjacent to the site, and parts of Conwy Bay, appear to be a hotspot for sandeels *Ammodytes* spp in Welsh waters (Campanella and van der Kooij, 2021; Ellis et al., 2012). There are also spring aggregations of Atlantic herring *Clupea harengus* in this area, potentially using the area for spawning. This area is also used as spawning and nursery areas by whiting *Merlangius merlangus*, plaice *Pleuronectes platessa* and sole *Solea solea* (Ellis *et al*., 2000; 2012).

The suitability of areas as fish feeding, nursery and spawning grounds is determined by the presence of suitable food supply, protection from the open sea, a lack of predators, and suitable physical characteristics, such as salinity and temperature. The importance of the large shallow bay as a feeding, nursery and / or spawning area is at least in part due to the shelter provided by the headlands of Point Lynas and the Great Orme. It is also due to its relatively shallow depth (<20m, with much of the large shallow bay being <10m depth), while being in close proximity to deeper offshore waters, with faster tidal currents, combined with the type of seabed substrate. Warmer water temperatures as the rising tide moves across shallow subtidal and intertidal areas are also likely to be an important factor for feeding juvenile fish.

A survey undertaken in 2001 caught 16 species of fish at Red Wharf Bay compared with an average of 9 species at the other sandbanks surveyed within Wales. The catch was dominated by dab *Limanda limanda*, sand goby *Pomatoschistus minutus*, *solenette Buglossidium luteum* and dragonet *Callionymus lyra*. It is likely that the fish assemblage associated with the Conwy Bay Bank is similar. In addition, several skate and ray species including the common skate *Dipturus batis*, the blonde ray *Raja brachyura* and the thornback ray or roker *Raja clavata* appear to be associated with sandbank areas within Red Wharf and Conwy Bays, as well as the wider sediment systems within the LSIB feature (Kaiser et al., 2004). While all of the species associated with the LSIB feature may contribute to the overall integrity of the SAC, a number of species, including 'Species of principal importance in Wales', 'Species of Conservation Concern' and 'Nationally rare species' have been recorded in the LSIB. These are the thumbnail crab *Thia scutellata*, the ocean quahog *Arctica islandica*, the spiny cockle *Acanthocardia aculeata*, the common skate *Dipturus batis*, the blonde ray *Raja brachyura* and the thornback ray or roker *Raja clavata*.

Submerged or partially submerged sea caves

Sea cave habitat

A variety of species are associated with the sea caves feature, including the plants and animals that live attached to the rock surfaces within the caves and mobile species associated with the cave floors and the water column inside the caves. Many species can also be associated with the habitats created by the animals attached to the rock surfaces within the caves, whilst other species live in crevices, overhangs, cracks and fissures in the cave walls and floors.

Intertidal sea cave communities are strongly influenced by humidity and air temperature, which in turn, is influenced by air movement. Although overall air movement is climatic, movement may be reduced in sea caves depending on their structure and exposure to wave action. Air temperatures may be buffered as a result of restricted airflow, seawater and / or underground rock temperatures, and incident sunlight, compared to the adjacent external environments. Humidity may also be elevated as a result of reduced airflow as well as use by grey seals.

Sea cave communities

Within the larger intertidal caves of Menai Strait and Conwy Bay SAC areas of the floors are typically scoured smooth and barren, whilst the upper parts of the walls at the cave rears are covered in a thin biotic film with small blue mussels *Mytilus edulis* and barnacles such as *Semibalanus balanoides* and *Austrominius modestus* occurring in cracks. Algal crusts and films occur on the main parts of the cave walls, with dense zones of barnacles, tubeworm *Spirorbis* spp., blue mussels *Mytilus edulis* and short turfs of sea firs such as the bushy wine-glass hydroid *Obelia dichotoma*. Lower wall areas are scoured, with occasional barnacles, tubeworms and keel worms *Spirobranchus* spp. Overhang areas within these caves are dominated by mussels, barnacles and plumose anemones *Metridium dianthus*. Toward the cave entrances the walls (in most cases) descend into the shallow subtidal and the rock beneath overhangs is typically covered by the silty tubes of the worm *Polydora* spp., dense turfs of sea anemones including the fried egg anemone *Sagartia elegans* and plumose anemones *Metridium dianthus* as well as sea squirts including *Polycarpa scuba* and the baked bean sea squirt *Dendrodoa grossularia* overlaying a crust of barnacles and tubeworms.

Submerged floors and ledges in many of the sea caves appear to support particularly high densities of velvet swimming crab *Necora puber* and the common prawn *Palaemon serratus*. Smaller caves support interesting communities of encrusting sponges, sea mats, mussels, barnacles and sea firs. In addition, a variety of anemones and sea squirts can be found in damper caves and crevices. In more wave-sheltered locations, many of the intertidal caves are characterised by turfs of red seaweeds such as *Rhodochorton purpureum* and *Hildenbrandia rubra*, with filamentous green seaweeds such as *Cladophora* spp.

As many of the sea caves in the SAC occur in limestone, species able to bore into the soft rock. These include the acorn worm *Phoronis hippocrepia*, the rock-boring sponges *Cliona celata* and *Microciona atrasanguinea* and the tube-dwelling worm *Polydora* spp.. Rock boring bivalves such as the wrinkled rock borer *Hiatella arctica* are particularly numerous in the lower shore and subtidal sections of the caves. Empty rock borer holes are home to many small invertebrates such as broad and long-clawed porcelain crabs *Porcellana platycheles* and *Pisidia longicornis*, juveniles of other crustacean species, brittlestars such as *Ophiothrix fragilis* and sea squirts (Bunker and Holt, 2003).

Appendix 2: Additional conservation interest

Sites of special scientific interest (SSSIs) wholly or partly in the SAC:

- Y Foryd/ The Foryd
- Glannau Porthaethwy
- Coedydd Afon Menai
- Traeth Lafan
- Glannau Penmon – Biwmares
- Arfordir Gogleddol Penmon
- Aber Afon Conwy
- Pen y Gogarth / Great Ormes Head
- Creigiau Rhiwledyn / Little Ormes Head

Special protection areas (SPA) wholly or partly in the SAC:

- Morwenoliaid Ynys Môn / Anglesey Terns
- Traeth Lafan / Lavan Sands
- Bae Lerpwl / Liverpool Bay

Section 7 and OSPAR threatened and declining habitats and species that occur within the SAC:

- *Arctica islandica*
- *Clupea harengus*
- *Edwardsia timida*
- Estuarine rocky habitats
- Intertidal mudflats
- Intertidal underboulder communities
- Mussel beds
- *Ostrea edulis*

- Peat and Clay exposures
- *Pleuronectes platessa*
- *Raja clavate*
- *Raja montagui*
- Seagrass beds
- Sheltered muddy gravels
- *Solea solea*
- Subtidal mixed muddy sediments
- Tide swept channels