Ariennir gan
Lywodraeth Cymru
Funded by
Welsh Government

Cyfoeth Naturiol Cymru
Natural Resources Wales

Condition assessments for allis shad *Alosa alosa* and twaite shad *Alosa fallax* in Welsh marine special areas of conservation

Report No: 891

Author Name: E. Wynter, M. Hatton-Ellis, A. Scorey, I. Nielsen, T. Hatton-Ellis, M. Jackson-Bué, and S. Cuthbertson

Author Affiliation: Natural Resources Wales

Twaite shad © NRW

About Natural Resources Wales

Natural Resources Wales' purpose is to pursue sustainable management of natural resources. This means looking after air, land, water, wildlife, plants and soil to improve Wales' well-being, and provide a better future for everyone.

Evidence at Natural Resources Wales

Natural Resources Wales is an evidence-based organisation. We seek to ensure that our strategy, decisions, operations and advice to Welsh Government and others are underpinned by sound and quality-assured evidence. We recognise that it is critically important to have a good understanding of our changing environment.

We will realise this vision by:

- Maintaining and developing the technical specialist skills of our staff;
- Securing our data and information;
- Having a well resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

This Evidence Report series serves as a record of work carried out or commissioned by Natural Resources Wales. It also helps us to share and promote use of our evidence by others and develop future collaborations.

Report series:	Marine Protected Area Feature Condition Assessments 2025
Report number:	891
Publication date:	June 2025
Title:	**Condition assessments for allis shad *Alosa alosa* and twaite shad *Alosa fallax* in Welsh marine special areas of conservation**
Author(s):	E. Wynter, M. Hatton-Ellis, A. Scorey, I. Nielsen, T. Hatton-Ellis, M. Jackson-Bué, and S. Cuthbertson
Technical editor:	Hatton-Ellis, M.
Quality assurance:	Tier three
Contributors:	Clabburn, P., Cooper Davies, R.A., Evans, R., Evans, S., Gott, S., Hyatt, P., Rees, S., Thornton, L.

Peer Reviewer(s):	Butterill, G., Camplin, M., Davis, S., Ellis, T., Gjerlov, C., Haines, L. Moon, J., Pauls., L., Ramsey, K., Sharp, J., Winterton, A.
Approved by:	Winterton, A.
Series editor(s):	Hatton-Ellis, M.
Restrictions:	None

Distribution List (core)

NRW Library	2
National Library of Wales	1
British Library	1
Welsh Government Library	1
Scottish Natural Heritage Library	1
Natural England Library (Electronic Only)	1

Recommended citation for this volume:

Wynter, E., Hatton-Ellis, M., Scorey, A., Nielsen, I., Hatton-Ellis, T., Jackson-Bué, M. and Cuthbertson, S. (2025). Condition assessments for allis shad *Alosa alosa* and twaite shad *Alosa fallax* in Welsh marine special areas of conservation. NRW Evidence Report No: 891, 61pp, Natural Resources Wales, Cardiff.

Contents

List of Figures

List of Tables

Crynodeb Gweithredol

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

Mae'r adroddiad tystiolaeth hwn, a gyflwynwyd fel rhan o brosiect gwella cyngor cadwraeth forol (IMCA) a ariannwyd gan Lywodraeth Cymru, yn cyflwyno canfyddiadau asesiadau cyflwr Cyfoeth Naturiol Cymru ar gyfer Herlyn *Alosa alosa* a Gwangen *Alosa fallax* o fewn ardaloedd cadwraeth arbennig dynodedig (ACA) ledled Cymru. Mae Adran 1 yn rhoi trosolwg o'r broses asesu ac mae Adran 2 yn darparu disgrifiad a lleoliad y nodwedd(ion).

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

Crynodeb o asesiadau cyflwr ar gyfer Herlyn mewn ACAau ledled Cymru

Lleoliad y nodwedd ACA	Asesiad cyflwr	Hyder yn yr asesiad
Sir Benfro Forol	Anffafriol	Isel
Bae Caerfyrddin ac Aberoedd	Anffafriol	Medium

Crynodeb o asesiadau cyflwr ar gyfer Gwangen mewn ACAau ledled Cymru

Lleoliad y nodwedd ACA	Asesiad cyflwr	Hyder yn yr asesiad
Sir Benfro Forol	Anffafriol	Isel
Bae Caerfyrddin ac Aberoedd	Anffafriol	Isel

Executive Summary

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

This evidence report, which was delivered as part of the Welsh Government funded improving marine conservation advice (IMCA) project, presents the findings of NRW's condition assessments for allis shad *Alosa alosa* and twaite shad *Alosa fallax* within designated special areas of conservation (SACs) across Wales. Cross-border sites are not included in this report but will hopefully be considered in future. Section 1 gives an overview of the assessment process and section 2 provides a description of the feature including where each designated site for these features is located.

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

Summary of condition assessments for allis shad in SACs across Wales.

SAC feature occurs in	Condition assessment	Confidence in assessment
Pembrokeshire Marine	Unfavourable	Low
Carmarthen Bay and Estuaries	Unfavourable	Medium

Summary of condition assessments for twaite shad in SACs across Wales.

SAC feature occurs in	Condition assessment	Confidence in assessment
Pembrokeshire Marine	Unfavourable	Low
Carmarthen Bay and Estuaries	Unfavourable	Low

1. Introduction

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

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

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

1.1. Assessment process

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

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

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

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

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

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

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

2. Feature description

2.1. The allis shad *Alosa alosa*

The allis shad *Alosa alosa* is a member of the herring family. They have streamlined bodies covered with distinct, large, circular scales which form a toothed edge on the lower margin and an adipose membrane which partially covers each eye. Adults typically range from 45 to 50 cm in length, with females often larger than 70 cm (FishBase). In the marine environment, allis shad feed on a range of planktonic crustaceans, with some larger adults feeding on small schooling fish (FishBase). Fish mature at between 3-8 years.

Allis shad are a diadromous species (life cycle alternates between the marine environment and a freshwater environment). When in the marine environment, allis shad typically remain in coastal areas and tend to congregate around the major catchments where they reproduce (Aprahamian et al., 2003). They have been reported at depths of 10 to 150 m, and up to 300 m (Aprahamian et al., 2003). They migrate from the sea into estuaries and freshwater in April to June and have been recorded to go up to 800 km upstream in continental Europe. Their migration into freshwater environments is restricted by man-made obstacles such as dams or weirs, and this has been a major cause of their decline. Adults return to the sea after spawning, but a large number die before reaching the sea (FishBase). Only 5-6% of adults spawn more than once in their lifetime (FishBase).

Population declines in many parts of Europe have been attributed to the effects of pollution, overfishing and obstructions to migration within the river. Allis shad are now exceedingly rare in Wales, with a recent assessment placing them as Critically Endangered and Possibly Extinct (Nunn et al., 2023). As they spawn at the same time of year as the very similar twaite shad, detecting them is extremely difficult.

2.2. The twaite shad *Alosa fallax*

The twaite shad *Alosa fallax* is a member of the herring family. It is difficult to distinguish from its close relative allis shad, and they are known to hybridise. Both fish have streamlined bodies covered with distinct, large, circular scales which form a toothed edge on the lower margin and an adipose membrane which partially covers each eye. Twaite shad are commonly 40 cm in length (FishBase). The only reliable way of separating the two species is to examine the gills: twaite shad have only 40-60 gill-rakers (comb-like structures that are used to filter zooplankton) on the first gill arch, whereas allis shad have 90-130. In the marine environment, juveniles initially feed on mysids and other zooplankton, before switching to small fish such as sprats as they grow. Fish mature at 4-5 years.

Twaite shad are also a diadromous species, and their distribution is similar to that of allis shad. They have a depth range of 10 to 110 m, but typically remain at 10 to 20 m (Aprahamian et al., 2003). They also migrate for spawning between April and June, and they home to their native rivers. Once they have spawned, adults return to the sea and may spawn again for 3 to 4 seasons throughout their lifetime (FishBase). Upstream migration of both allis and twaite shad is likely to be triggered by temperature, and recruitment seems to be highest in warm years. High flows between May and August may result in fry being washed prematurely out to sea.

Twaite shad have a local distribution in Wales, with large populations in the Wye, Usk and Tywi. Nunn et al. (2023) assessed their status as Vulnerable. Population declines in many parts of Europe have been attributed to pollution, overfishing and migratory route obstructions.

There is currently work taking place to improve understanding of connectivity of twaite shad within the Bristol Channel, including the use of the wider area by River Tywi shad and use of the Carmarthen Bay SAC (Franconi et al., 2023).

3. Allis shad *Alosa alosa* condition assessments

This section contains condition assessments for the two Welsh only marine ardal cadwraeth arbennig (ACA) / special areas of conservation (SACs) where allis shad *A. alosa* is a designated feature (Figure 1).

- Sir Benfro Forol / Pembrokeshire Marine
- Bae Caerfyrddin ac Aberoedd / Carmarthen Bay and Estuaries

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

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

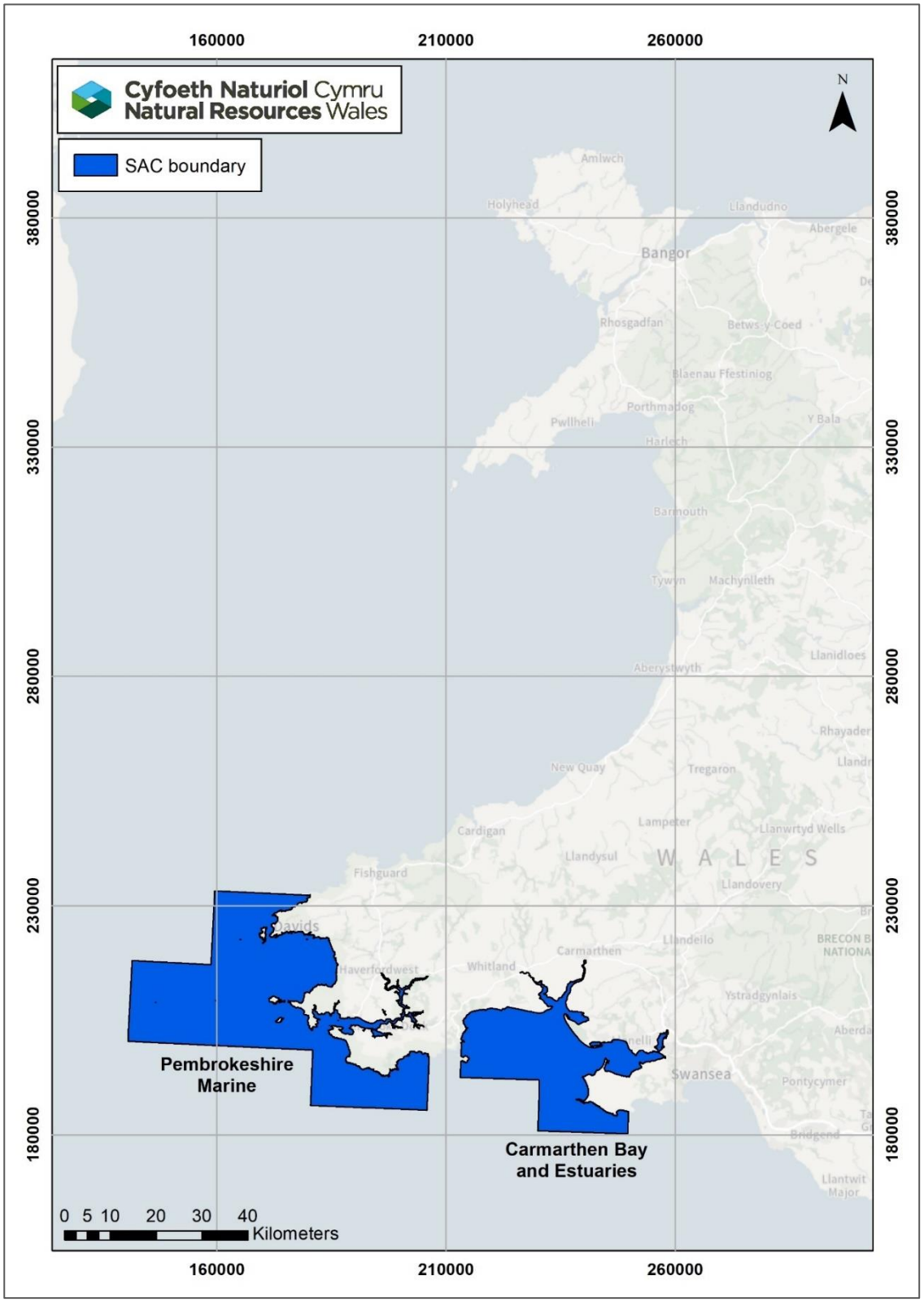
In these condition assessments, the WFD 2024 cycle 3 interim classification was the default information used for water quality, however other earlier cycles were referenced, as follows:

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

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

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

Figure 1. Location of SACs assessed for the allis shad feature.



3.1. Pembrokeshire Marine SAC condition assessment

Allis shad has been designated as a qualifying feature in Pembrokeshire Marine SAC as it has been considered an important coastal migration route or feeding ground for this species. There are no known historical spawning grounds in the freshwater catchments which drain into the SAC. A summary of the condition assessment for allis shad in Pembrokeshire Marine SAC can been seen in Table 2. The overall feature condition, a detailed summary of the assessment and threats to condition are discussed in more detail in the sections below.

Table 2. Condition assessment of allis shad in Pembrokeshire Marine SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Population variables and data	The wider population of allis shad relevant to the SAC should be stable or increasing in the long-term. (P)	• The historical population of allis shad within the SAC are thought to migrate between spawning grounds in the Rivers Tywi, Wye, Usk and Severn and this marine SAC. Records of the species in these rivers and records within the marine SAC have therefore been considered in the assessment. • There have been no confirmed records of allis shad in the Pembrokeshire Marine SAC. Population numbers are thought to be very low. • The historical collapse of the allis shad population in the River Severn was linked to weir construction. Barriers in the River Severn, and upstream tributaries in the Usk, are still present and are thought to be limiting the upstream migration of allis shad within these catchments. Within the River Tywi SAC, there have been no confirmed records of allis shad. • Although this indicator was assessed, data on allis shad are very limited and there have been no targeted surveys of the species in any of the marine SACs, therefore confidence is medium.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Habitat connectivity	Maintain safe passage and movement of allis shad in the marine environment into, within and away from the SAC. (P)	• There are no known barriers to marine migration within or into the Pembrokeshire Marine SAC. • There are no known barriers to migration in the Carmarthen Bay and Estuaries SAC and Severn Estuary SAC, and in the Bristol Channel that could impact allis shad in the Pembrokeshire Marine SAC. • Confidence is high as in depth site knowledge was used.	**Pass**	High
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities is not having a detrimental impact at the population level. (P)	• There are no known records of the INNS that are of particular concern for allis shad within Pembrokeshire Marine SAC. • Confidence is high due to the availability of long term monitoring data on the species of concern to allis shad.	**Pass**	High
Anthropogenic mortality: targeted exploitation	There should be no targeted exploitation of the species. (S)	• No targeted exploitation of allis shad is understood to be occurring. • Under the Wildlife & Countryside Act 1981 (as amended) it is illegal to take, kill or disturb (including fishing for) allis shad without a license. • Confidence is high as the assessment was based on expert judgement and knowledge that there are no fisheries that could capture the species in the SAC.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Anthropogenic mortality: abstraction and entrapment	Abstraction and entrapment should not adversely affect the viability of the population. (S)	• All licenced abstractions have previously been assessed through the Habitats Regulations Review of Consents (RoC) process, Eel Regulations, or Salmon and Freshwater Fisheries Act (SAFFA) 1975. • All new abstractions are required to go through permitting processes to comply with screening requirements for fish. • There has been no evidence of entrapment of allis shad recorded at Pembroke Power Station. • There are no other major operations within the SAC known to be causing entrapment of allis shad. • Confidence is high as all operations go through permitting processes and as the assessment has been based on up-to-date specialist knowledge and data.	**Pass**	High
Anthropogenic mortality: bycatch	Bycatch of the species should not adversely affect the viability of the population. (S)	• Bycatch of allis shad is thought to be low for the SAC population. • Pelagic fisheries in the Celtic Sea may have bycatch of allis shad but there are no data on the potential impact of this. • The indicator was assessed as unknown as there are no data to assess the extent and impact of bycatch of allis shad.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the environmental quality standards (EQS). (S)	• Four of the six WFD waterbodies in the SAC were not classified as the chemicals have not been assessed within the last six years (Pembrokeshire South, Cardigan Bay South, Grassholm Island and the Smalls, and Solfach Estuary). • One WFD waterbody has a fail for chemicals in the 2024 cycle 3 interim classification, due to polybrominated diphenyl ethers (PBDE) and polycyclic aromatic hydrocarbons (PAH) (Milford Haven Inner). • One WFD waterbody has a pass for chemicals (Milford Haven Outer). However, some of the chemical classifications were rolled forward from the 2021 cycle 3 classification. • Allis shad are likely to use the coastal areas of the SAC in migration routes, and are unlikely to spend a significant amount of time in the Milford Haven estuary as they do not migrate up the Cleddau Rivers. This indicator was therefore assessed as unknown as the coastal waterbodies have not been classified for this WFD element.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (P)	• Five of the six WFD waterbodies in the SAC have been classified as High status for dissolved oxygen in the 2024 cycle 3 interim classification. • All WFD waterbodies that have been assessed overlap with an extensive area within the SAC and are therefore considered to be representative of the area that allis shad would use in the SAC. • Confidence is medium as samples have been taken from the surface of waterbodies.	**Pass**	Medium
Water quality: physicochemical properties	Maintain natural physicochemical properties of water subject to natural variation. (T)	• Data from intertidal and subtidal temperature loggers were available. Some temperature loggers in the SAC showed an increase in the number of days with higher temperatures, and potential step change in temperature. • Pembroke Power Station report indicated a localised increase in temperature, which was deemed unlikely to be of wider ecological significance. • This indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).	**Unknown**	N/A

Assessment conclusions

The allis shad feature in Pembrokeshire Marine SAC has been assessed as being in **unfavourable** condition (low confidence). There was one indicator with a failing target (Table 3). The reason for low populations of allis shad in the SAC and across Wales is not known. The species is currently classified as Critically Endangered (presumed extinct) in Wales. The overall confidence was low as the assessment was based on expert judgement as there are limited data within the marine SAC. Further investigation is needed to better understand the failure to be able to identify management options that can bring the feature back into favourable condition.

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

Table 3. Summary of the condition assessment for allis shad in Pembrokeshire Marine SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for target failure	Threats to condition
Pembrokeshire Marine	**Unfavourable (low confidence)**	Population variables and data (P)	• There are critically low populations of allis shad across Wales.	• Industry • INNS • Water quality: contaminants • Climate change

Detailed assessment information

Population variables

A Red List Assessment concluded that allis shad are Critically Endangered (presumed extinct) in Wales (Nunn et al., 2023). Although it is possible that allis shad spawn in Wales, numbers are likely to be extremely small and hybridisation with twaite shad may mean that allis shad are functionally extinct in Wales. NRW has records of shad eggs which show that shad are spawning on a regular basis in the relevant river catchments. However, it is not possible to determine what species the eggs are.

There are no known historical allis shad spawning grounds in the freshwater catchments directly upstream of the Pembrokeshire Marine SAC (Cleddau Rivers SAC). The historical population of allis shad within the SAC are thought to migrate between spawning grounds in the Rivers Tywi and Severn (including the important tributaries, rivers Usk and Wye). As the SAC was designated for the species for use as a migration route, records of the species in the rivers that are thought to contribute to the SAC population, and expert judgement of their potential use of the marine SAC has been considered.

There have been no confirmed records of allis shad within the Pembrokeshire Marine SAC, and population numbers are thought to be very low. Detection is hampered by the lack of targeted surveys for this species in the marine environment.

Weir construction was thought to have been a primary reason for the collapse of the allis shad population in the River Severn in England (Aprahamian et al., 1998). The Unlocking the Severn Project has constructed a series of fish passes that open up 254 km of previously inaccessible river to shad, greatly improving the area of available habitat on the river and allowing access along the main Severn as far as Stourport. However, this only amounts to approximately half the distance of river that would previously have been available. Barriers in the Severn, and upstream tributaries in the Usk are still present and are thought to be limiting the upstream migration of allis shad within this catchment. Improvements are planned or in progress at the two weirs on the Usk to progress fish easement as part of the Four Rivers for LIFE project, and works have also been carried out on some of the weirs on the Severn in England as part of the Unlocking the Severn Project. Within the River Tywi SAC, which has historically been an important spawning river for the species, there have been no confirmed records of allis shad.

It should be noted that the shad population on the Tywi shows an unusually high proportion of allis shad haplotypes (72%), likely indicating past hybridisation with allis shad (Hardouin et al., 2013). For the purposes of these assessments, these individuals are considered to be twaite shad as allis shad numbers are very low across Wales. Hardouin et al. (2013) found that in the River Wye, 1% of the eggs studied were assigned to allis shad, compared to 70% for twaite shad, with 29% being hybrids. The Rivers Usk and Tywi had 0% proportions of allis shad.

The indicator linked to population failed to meet its set target primarily due to the lack of records within the Marine SAC, but also due to low populations in the historical spawning populations in the Rivers Tywi and Severn. The assessment was based on expert judgement as there are very limited data within the marine SAC. A medium confidence was therefore assigned to the fail. Although this indicator was assessed, data on allis shad

are very limited and there have been no targeted surveys of the species in any of the marine SACs. Surveys of allis shad are therefore required within the SAC.

Habitat connectivity

There are no known marine barriers in the Severn Estuary SAC and the Carmarthen Bay and Estuaries SAC, and along the coast in between that could impact allis shad in the Pembrokeshire Marine SAC. The indicator therefore passed its target with high confidence as there are no known issues with connectivity within the marine migration routes into and through the SAC.

The freshwater flow indicator is not applicable as there are no known spawning populations of allis shad in the freshwater catchments.

Invasive non-native species

The invasive non-native species (INNS) that could significantly impact the allis shad are Chinese mitten crab and Signal crayfish. There have been no known records of these species within the Pembrokeshire Marine SAC. There are no other known INNS considered likely to affect allis shad within the SAC. The INNS indicator therefore passed its target with a high confidence.

Anthropogenic mortality

There is no known targeted exploitation of allis shad within Pembrokeshire Marine SAC therefore this indicator passed its target. Under the Wildlife & Countryside Act 1981 (as amended) it is illegal to take, kill or disturb (including fishing for) allis shad without a license. Any specimens caught unintentionally must be released alive. High confidence was attributed to the indicator pass as it was based on expert judgement and knowledge that there are no fisheries that could capture the species in the site, especially given the low population numbers.

In Wales, all licenced abstractions have been assessed through Habitats Regulations Review of Consents (RoC) process, Eel Regulations, or Salmon and Freshwater Fisheries Act (SAFFA) 1975 to ensure that all permitted abstractions are screened to minimise entrainment of fish. Pembroke Power Station abstracts water from the SAC. Annual impingement and entrainment monitoring conducted at the power station has not recorded any allis shad since the commencement of operation (RWE, unpublished data). The power station may pose a threat due to the abstraction and possibility of entrainment or impingement, but monitoring suggests no current impacts to the species. Therefore, it has been identified as not posing a significant impact to allis shad. There are no other major operations within the Pembrokeshire Marine SAC known to be causing entrapment of allis shad. The abstraction and entrapment target was therefore assessed as passing with high confidence as all operations go through regulated screening permitting processes and as the assessment has been based on up-to-date specialist knowledge and data.

Bycatch of allis shad within the Pembrokeshire Marine SAC is thought to be minimal, particularly given the population levels. There may be some bycatch of allis shad in the pelagic fisheries in the Celtic Sea, however there are no data on the potential impact of

this on the SAC population. As there are no data to assess the extent and impact of bycatch of allis shad, the indicator was assessed as unknown.

Water quality

There are six WFD waterbodies within the Pembrokeshire Marine SAC: Pembrokeshire South, Cardigan Bay South, Grassholm Island and the Smalls, Milford Haven Outer, Milford Haven Inner, and Solfach Estuary. The water quality indicator conclusions also apply to twaite shad.

Contaminants

The Milford Haven Inner waterbody has a fail for chemicals in the 2024 cycle 3 interim classification, where PBDE and PAH failed. The Milford Haven Outer waterbody failed for mercury and TBT in previous cycles. This waterbody now passes for chemicals in the 2024 cycle 3 interim classification, however TBT, which was previously a failing chemical, is no longer assessed. In addition, mercury was not classified in the 2024 cycle 3 interim classification. The other four WFD waterbodies were not classified as the chemicals have not been assessed within the last six years. Allis shad in the SAC are designated for use of the site as a migration route through coastal areas, therefore the species is unlikely to spend a significant amount of time in the Milford Haven estuary. The indicator was therefore assessed as unknown as the coastal waterbodies have not been assessed for the chemicals.

Dissolved oxygen

The dissolved oxygen indicator passed its target as five of the six WFD waterbodies in the SAC were classified as High status for the dissolved oxygen element in the 2024 cycle 3 interim classification. These WFD waterbodies overlap with an extensive area in the coastal part of the SAC and are therefore considered to be representative of the areas potentially used by allis shad in Pembrokeshire Marine SAC. The dissolved oxygen samples are taken at the water's surface. By the time oxygen depletion at the surface is recorded, oxygen throughout the water column could have been depleted for some time, especially as hypoxia or low oxygen levels, when present, typically occur in bottom water and sediments. Therefore surface sampling of dissolved oxygen may not detect issues throughout the water column or for more demersal features. This reduced the confidence in the pass to medium.

Physicochemical properties

Data from seven NRW monitored subtidal temperature loggers and six NRW monitored intertidal monitoring sites at various shore heights (12 temperature loggers in total) were available. Some of the loggers showed an increase in the number of days with higher temperatures, and a potential step change in temperature. This is more apparent in the loggers within the Milford Haven estuary. An external report (Sutton, 2023) found localised increase in temperature near the Pembroke Power Station. However, they concluded that this is unlikely to be of wider ecological significance. While localised, warming water can provide a safe haven for NNS, which could then spread further. This will be something to pay close attention to in the next assessment. The physicochemical indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and as further evidence on the apparent temperature change is needed for a

comprehensive assessment. In addition because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).

Reasons for target failure

The assessment of allis shad in Pembrokeshire Marine SAC failed one primary target. This resulted in the allis shad feature to be assessed as being in **unfavourable** condition. The failing indicator and reasons for failure, if known, are stated below.

Population variables and data

The population indicator target was not met as there have been no confirmed records of allis shad within the SAC. In the wider region, allis shad are classified as Critically Endangered (presumed extinct) in Wales. Data on allis shad are very limited and there have been no targeted surveys of the species in any of the marine SACs. On the River Severn in England, weir construction was thought to have been a primary reason for the historical collapse of the allis shad population in the river (Aprahamian et al., 1998).

Threats to condition

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

Industry

Any planned installations and projects which could impinge or entrap allis shad, and therefore have the potential to impact the species at a population level, need to be considered carefully, given the low population levels.

Invasive non-native species

There are currently no records of Chinese mitten crab in the Pembrokeshire Marine SAC. However they could be introduced to the area.

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

Water quality: contaminants

At the time of the assessment, allis shad are thought not to be adversely impacted by contaminants at the population level. There is the potential for unregulated contaminants (such as Per- and polyfluoroalkyl substances (PFAS)) to increase. This could affect allis shad as PFAS has been shown to bioaccumulate in marine species, increasing up the

trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

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

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counteract each other. However, threats from climate change that could impact the species may include:

- Increasing sea surface and river temperature.
- Changes to prey availability and abundance.

3.2. Carmarthen Bay and Estuaries SAC condition assessment

Allis shad has been designated as a qualifying feature in Carmarthen Bay and Estuaries SAC as it is considered an important coastal migration route or feeding ground, and as the upstream catchment (River Tywi SAC) has historically supported a substantial spawning population. There may be other relevant rivers that contribute to the SAC population. A summary of the condition assessment for allis shad in Carmarthen Bay and Estuaries SAC can been seen in Table 4. The overall feature condition, a detailed summary of the assessment and threats to condition are discussed in more detail in the sections below.

Table 4. Condition assessment of allis shad in Carmarthen Bay and Estuaries SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Population variables and data	The population of allis shad relevant to the SAC should be stable or increasing in the long-term. (P)	• There have been no confirmed recent records of allis shad within the River Tywi SAC. • There have also been no confirmed recent records of allis shad in the Carmarthen Bay and Estuaries SAC. Population numbers are thought to be very low. • Records of the species in the Rivers Severn, Wye and Usk have been considered as allis shad could migrate between the SAC and these spawning grounds. The historical collapse of the allis shad population in the River Severn was linked to weir construction. Barriers in the Severn and its tributaries are still present and are thought to be limiting the upstream migration of allis shad within this catchment. • Although this indicator was assessed, data on allis shad are very limited and there have been no targeted surveys of the species in any of the marine SACs, therefore confidence is medium.	**Fail**	Medium

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Habitat connectivity	Maintain safe passage and movement of allis shad in the marine environment into, within and away from the SAC, including to and from the connected spawning locations. (P)	• There are no known barriers to marine migration within or into the Carmarthen Bay and Estuaries SAC. • There are no known barriers to migration in the Severn Estuary SAC and in the Bristol Channel that could impact allis shad in the Carmarthen Bay and Estuaries SAC. • Confidence is high as in depth site knowledge was used.	**Pass**	High
Freshwater flow	Maintain freshwater flow to the estuary / estuaries within the SAC. Regulated rivers meet their minimum flow targets. (P)	• There are no known issues affecting the freshwater flow to the Carmarthen Bay and Estuaries SAC that would affect allis shad migration. • There are no known issues within the River Tywi SAC catchment affecting freshwater flow to the Three Rivers estuary. • Licenced abstractions on the River Tywi SAC have gone through the RoC process to ensure designated features are adequately protected. • Flow data were not analysed for this assessment therefore confidence is medium.	**Pass**	Medium
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities is not having a detrimental impact at the population level. (P)	• There are no known records of the INNS that are of particular concern for allis shad within Carmarthen Bay and Estuaries SAC and associated River Tywi SAC. • Confidence is high due to the availability of long term monitoring data on the species of concern to allis shad.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Anthropogenic mortality: targeted exploitation	There should be no targeted exploitation of the species. (S)	• No targeted exploitation of allis shad is understood to be occurring. • Under the Wildlife & Countryside Act 1981 (as amended) it is illegal to take, kill or disturb (including fishing for) allis shad without a license. • Confidence is high as the assessment was based on expert judgement and knowledge that there are no fisheries that could capture the species in the SAC.	**Pass**	High
Anthropogenic mortality: abstraction and entrapment	Abstraction and entrapment should not adversely affect the viability of the population. (S)	• All licenced abstractions have previously been assessed through the Habitats Regulations RoC process, Eel Regulations, or SAFFA 1975. • All new abstractions are required to go through permitting processes to comply with screening requirements for fish. • There are no major operations within the SAC or rivers draining into the SAC known to be causing entrapment of allis shad. • Confidence is high as all operations go through permitting processes and as the assessment has been based on up-to-date specialist knowledge and data.	**Pass**	High
Anthropogenic mortality: bycatch	Bycatch of the species should not adversely affect the viability of the population. (S)	• Bycatch of allis shad is thought to be low for the SAC population. • Pelagic fisheries in the Celtic Sea may have bycatch of allis shad but there are no data on the potential impact of this. • The indicator was assessed as unknown as there are no data to assess the extent and impact of bycatch of allis shad.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Fish Community	The WFD Estuarine Fish tool is at least good. (T)	• The estuarine fish WFD element is assessed in transitional WFD waterbodies only. • Neither of the two transitional WFD waterbodies in the SAC (Burry Inlet Inner and Three Rivers Estuary) were assessed for the estuarine fish WFD element in the 2024 cycle 3 interim classification. • The indicator was therefore assessed as unknown.	**Unknown**	N/A
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• Three of the four WFD waterbodies in the SAC have a pass for chemicals in the 2024 cycle 3 interim classification (Burry Inlet Inner, Burry Inlet Outer and Three Rivers Estuary). In all waterbodies, some or all of the chemical classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. • The other WFD waterbody has a fail for chemicals (Carmarthen Bay). It failed for mercury, PBDE and cypermethrin. • Confidence is low as: the human health standard has been used for PBDE; some chemical classifications were rolled forward; and contaminants are not directly monitored in this species.	**Fail**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (P)	• All four WFD waterbodies in the SAC have been classified as High status for dissolved oxygen in the 2024 cycle 3 interim classification. • All WFD waterbodies that have been assessed overlap with an extensive area within the SAC and are therefore considered to be representative of the area that allis shad would use in the SAC. • Confidence is medium as samples have been taken from the surface of waterbodies.	**Pass**	Medium

Assessment conclusions

The allis shad feature in Carmarthen Bay and Estuaries SAC has been assessed as being in **unfavourable** condition (medium confidence). There were two indicators with failing targets (Table 5). The reason for low populations of allis shad in the SAC and across Wales is not known. The species is currently classified as Critically Endangered (presumed extinct) in Wales. The confidence was reduced to medium as the assessment was based on expert judgement as there are limited data within the marine SAC. Further investigation is needed to better understand the failure to be able to identify management options that can bring the feature back into favourable condition.

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

Table 5. Summary of the condition assessment for allis shad in Carmarthen Bay and Estuaries SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for target failure	Threats to condition
Carmarthen Bay and Estuaries	**Unfavourable (medium confidence)**	Population variables and data (P) Water quality: contaminants (S)	• There are critically low populations of allis shad across Wales. • Levels of mercury, PBDE and cypermethrin in the Carmarthen Bay waterbody are failing to meet their relevant EQSs.	• Industry • INNS • Water quality: contaminants • Climate change

Detailed assessment information

Population variables

Allis shad are classified as Critically Endangered (presumed extinct) in Wales. Although it is possible that allis shad spawn in Wales, numbers are likely to be extremely small and hybridisation with twaite shad probably means that allis shad are functionally extinct in Wales (Nunn et al., 2023). NRW has records of shad eggs which show that shad are spawning on a regular basis in the relevant river catchments. However, it is not possible to determine which species the eggs are from.

The River Tywi is one of the only three rivers in Wales where there are substantial spawning populations of shad. It should be noted that the shad population on the Tywi shows an unusually high proportion of allis shad haplotypes (72%), likely indicating past hybridisation with allis shad (Hardouin et al., 2013). For the purposes of these assessments, these individuals are considered to be twaite shad as allis shad numbers are very low across Wales. Hardouin et al. (2013) found that in the River Wye, 1% of the eggs studied were assigned to allis shad, compared to 70% for twaite shad, with 29% being hybrids. The Rivers Usk and Tywi had 0% proportions of allis shad. There have been no confirmed records of allis shad in the Carmarthen Bay and Estuaries SAC and River Tywi SAC, and population numbers are thought to be very low. Detection is hampered by the lack of targeted surveys for this species in the marine environment.

As the SAC is designated as a migration route for the species, in addition to being directly connected to a historical spawning population in the River Tywi SAC, records of the species in the River Severn and its tributaries have been considered as allis shad could migrate between the SAC and these spawning grounds. Weir construction was thought to have been a primary reason for the collapse of the allis shad population in the River Severn in England (Aprahamian et al., 1998). The Unlocking the Severn Project has constructed a series of fish passes that open up 254 km of previously inaccessible river to shad, greatly improving the area of available habitat on the river and allowing access along the main Severn as far as Stourport. However, this only amounts to approximately half the distance of river that would previously have been available. Barriers in the Severn, and upstream tributaries in the Usk are still present and are thought to be limiting the upstream migration of allis shad within this catchment. Improvements are planned or in progress at the two weirs on the Usk to progress fish easement as part of the Four Rivers for LIFE project, and works have also been carried out on some of the weirs on the Severn in England as part of the Unlocking the Severn Project.

The indicator linked to population failed to meet its set target, primarily due to the low number of records of the species within the Carmarthen Bay and Estuaries SAC, and connected River Tywi SAC. The assessment was based on expert judgement, therefore confidence of the fail was reduced to medium. Although this indicator was assessed, data on allis shad are very limited and there have been no targeted surveys of the species in the marine SAC or upstream rivers. Surveys of allis shad are therefore required within the SAC.

Habitat connectivity and freshwater flow

There are no known marine barriers within the Carmarthen Bay and Estuaries SAC and from the Severn Estuary SAC, or along the coast in between that could impact allis shad in the Carmarthen Bay and Estuaries SAC. The indicator therefore passed its target with high confidence as there are no known issues with connectivity within the marine migration routes into and through the SAC.

All licenced abstractions on the River Tywi SAC went through the RoC process which ensured that designated features, including migratory shad, were adequately protected. This indicator in the Carmarthen Bay and Estuaries SAC does not include a specific freshwater flow target. Flow data are available at some locations within the contributing rivers. The freshwater flow indicator therefore passed the target as there are no known issues with flow to the Three Rivers estuary or River Tywi SAC that drains into the Carmarthen Bay and Estuaries SAC. Confidence in the pass is medium as flow data were not used for the assessment.

Invasive non-native species

The INNS that could significantly impact the allis shad are Chinese mitten crab and Signal crayfish. There have been a small number records of signal crayfish near Llandelio, and there is a population in the Nant Gurrey Fach that may have spread into neighbouring areas. These are tributaries that drain into the River Tywi SAC. There are no other known records of these species within the Carmarthen Bay and Estuaries SAC or the River Tywi SAC catchment. The INNS indicator therefore passed the target with a high confidence.

Anthropogenic mortality

There is no known targeted exploitation of allis shad within Carmarthen Bay and Estuaries SAC therefore this indicator passed its target. Under the Wildlife & Countryside Act 1981 (as amended) it is illegal to take, kill or disturb (including fishing for) allis shad without a license. Any specimens caught unintentionally must be released alive. High confidence was attributed to the indicator pass as it was based on expert judgement and knowledge that there are no fisheries that could capture the species in the site, especially given the low population numbers.

In Wales, all licenced abstractions have been assessed through Habitats Regulations RoC process, Eel Regulations, or SAFFA 1975 to ensure that all permitted abstractions are screened to minimise entrainment of fish. There are no major operations such as power stations within the Carmarthen Bay and Estuaries SAC or rivers draining into the SAC known to be causing entrapment of allis shad. The abstraction and entrapment target was therefore assessed as passing with high confidence as all operations go through regulated screening permitting processes and as the assessment has been based on up-to-date specialist knowledge and data. There were power stations in the Bristol channel which may have impacted the allis shad that originate in the Severn. These are no longer operational and abstraction has significantly reduced therefore they are no longer considered a threat to allis shad.

Bycatch of allis shad within the Carmarthen Bay and Estuaries SAC is thought to be low, particularly given the population levels. There may be some bycatch of allis shad in the

pelagic fisheries in the Celtic Sea, however there are no data on the potential impact of this on the SAC population. As there are no data to assess the extent and impact of bycatch of allis shad, the indicator was assessed as unknown.

Fish community

The fish community indicator was assessed as unknown for allis shad in the Carmarthen Bay and Estuaries SAC due to an absence of data. The WFD estuarine fish tool is used as a proxy for habitat quality for fish in general in estuaries. If this element is classified as Good status it is likely that the conditions for fish, and therefore allis shad, are favourable. The estuarine fish element is assessed in the transitional WFD waterbodies only. Within the SAC there are two transitional WFD waterbodies, the Burry Inlet Inner and Three Rivers Estuary waterbodies, and neither has been assessed in the 2024 cycle 3 interim classification. The Three Rivers Estuary waterbody was previously assessed with a Moderate status in the 2009 cycle 1 classification but it has not been assessed since. The methodology used in the WFD fish classification has changed since the 2009 cycle 1 classification. As the cycle 1 information is not comparable to the current methodology, it has not be used.

Water quality

There are four WFD waterbodies within the Carmarthen Bay and Estuaries SAC: Carmarthen Bay, Burry Inlet Outer, Burry Inlet Inner, and the Three Rivers Estuary (Tywi, Taf and Gwendraeth). The water quality indicator conclusions also apply to twaite shad.

Contaminants

The Carmarthen Bay waterbody has a fail for chemicals in the 2024 cycle 3 interim classification, where mercury, PBDE and cypermethrin failed. The EQS for cypermethrin is very low, and in the previous lab methodology it was not possible to detect concentrations below the EQS. There has been a waterbody status change (pass to fail) between the 2021 cycle 3 classification and 2024 cycle 3 interim classification due to this reason. Cypermethrin is a synthetic pyrethroid insecticide and is highly toxic to some aquatic species (EA, 2019), but now has a restricted use in Wales. Mercury has failed in the waterbody since the 2015 cycle 2 classification. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife). The PBDE failure was based on the value of the human health protection goal as it is the most stringent. This protection goal may be over precautionary as the effect of contaminants on the allis shad feature are not fully understood. The Carmarthen Bay waterbody overlaps with a large area in the SAC, therefore the chemical failure there has resulted in the failure for the contaminants indicator. The other three WFD waterbodies have a pass for chemicals in the 2024 cycle 3 interim classification. However, in all three waterbodies, some or all of the chemical classifications were rolled forward from previous cycles as they were not assessed in the 2024 cycle 3 interim classification.

Overall, a low confidence was assigned to the failure of the contaminants indicator because the human health standard has been used for PBDE, and due to the roll forward in some chemical classifications. In addition, the effect of the chemical failure on the species is uncertain, and the contaminants have not been directly monitored in this species.

Dissolved oxygen

The dissolved oxygen indicator passed its target as all four WFD waterbodies in the SAC were classified as High status for the dissolved oxygen element in the 2024 cycle 3 interim classification. These WFD waterbodies overlap with an extensive area in the coastal part of the SAC and are therefore considered to be representative of the areas potentially used by the allis shad feature in the Carmarthen Bay and Estuaries SAC. Confidence in the pass was reduced to low because surface sampling of dissolved oxygen may not detect issues throughout the water column or for more demersal features (see further detail in section 3.1).

Physicochemical properties

The physicochemical indicator could not be assessed due to a lack of data.

Reasons for target failure

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

Population variables and data

The population indicator target was not met as there have been no confirmed records of allis shad within the SAC. In the wider region, allis shad are classified as Critically Endangered (presumed extinct) in Wales. Data on allis shad are very limited and there have been no targeted surveys of the species in any of the marine SACs. On the River Severn in England, weir construction was thought to have been a primary reason for the historical collapse of the allis shad population in the river (Aprahamian et al., 1998).

Water quality: contaminants

This indicator failed to meet its secondary target due to the failure of chemical status in the Carmarthen Bay waterbody, which failed for mercury, PBDE and cypermethrin. Historically, the main source of PBDE is as flame retardants in a variety of materials (Viñas et al., 2022). Mercury has been used in many industries, but today the primary sources are burning of coal and artisan mining for mercury (Larsen and Hjermann, 2022). Cypermethrin is an insecticide used for plant protection in crops, in forestry, gardens, homes and businesses. It is also used in veterinary medicine to control pests in livestock and pets (EA, 2019). The application of cypermethrin has been restricted for some uses (sheep dipping and in forestry against the pine weevil).

Some of the contaminants in the water column may be derived from diffuse sources from atmospheric deposition and contaminated waterbody bed sediments, or point sources from continuous sewage discharge from wastewater treatment. However, a WFD investigation of the failure in the Carmarthen Bay waterbody is yet to be undertaken. Mercury and PBDE are being managed in the UK and it is hoped that these levels will reduce in time.

Threats to condition

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

Industry

Any planned installations and projects which could impinge or entrap allis shad, and therefore have the potential to impact the species at a population level, need to be considered carefully, given the low population levels.

Invasive non-native species

There have been some records of signal crayfish in the tributaries that drain into the River Tywi SAC. Signal crayfish would predate on eggs of the allis shad. There are currently no records of Chinese mitten crab in the Carmarthen Bay and Estuaries or River Tywi SACs. There is a threat that these could be introduced to the area.

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

Water quality: contaminants

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

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

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counteract each other. However, threats from climate change that could impact the species may include:

- Increasing sea surface and river temperature.
- Changes in precipitation impacting riverine flow in spring and summer, affecting the ability of adults to pass partial barriers and causing washout of eggs and juveniles.
- Changes to prey availability and abundance.

4. Twaite shad *Alosa fallax* condition assessments

This section contains condition assessments for the two Welsh only marine ACAs / SACs where twaite shad *Alosa fallax* is a designated feature (Figure 2).

- Sir Benfro Forol / Pembrokeshire Marine
- Bae Caerfyrddin ac Aberoedd / Carmarthen Bay and Estuaries

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

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

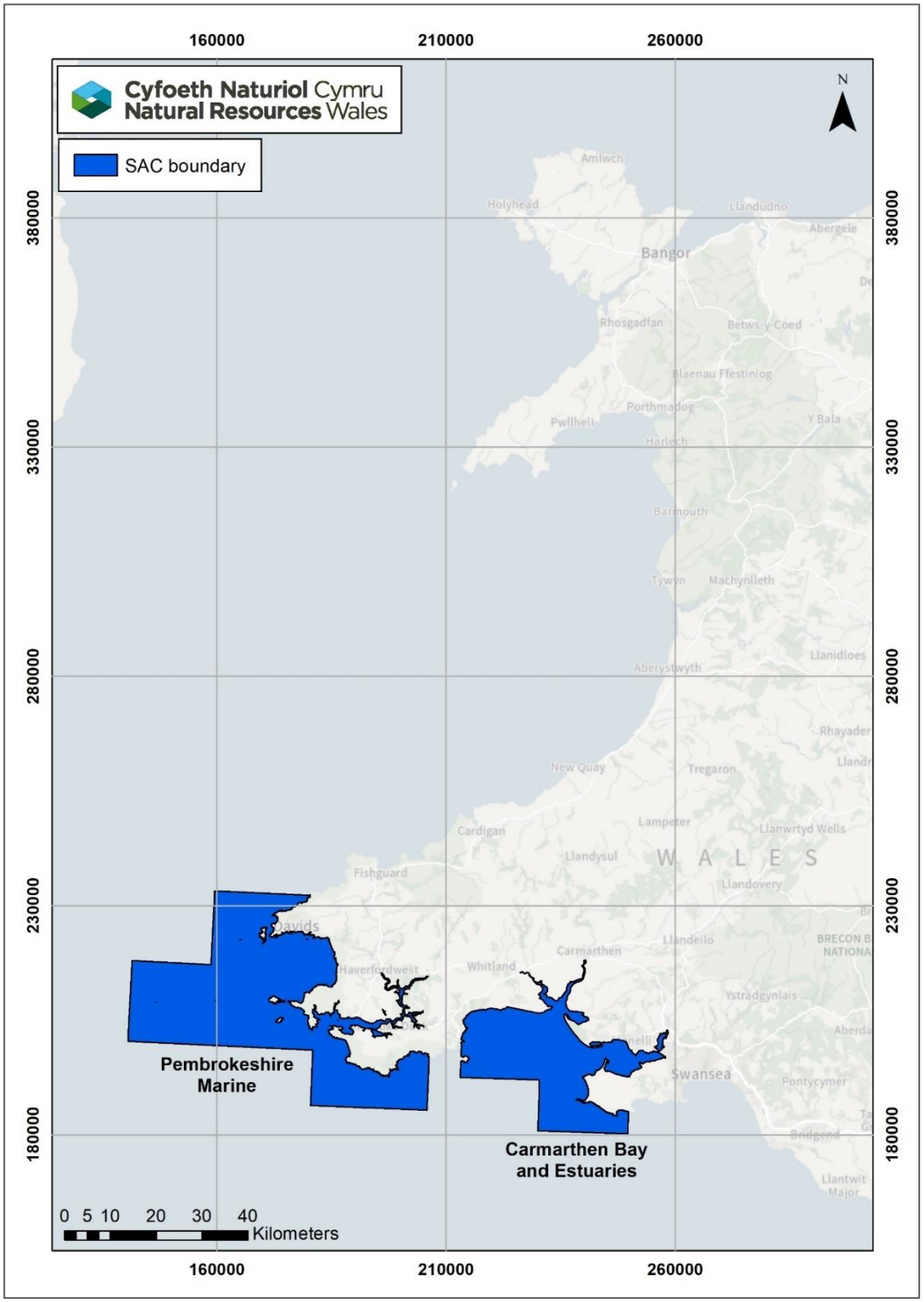
In these condition assessments, the WFD 2024 cycle 3 interim classification was the default information used for water quality, however other earlier cycles were referenced, as follows:

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

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

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

Figure 2. Location of SACs assessed for the twaite shad feature.



4.1. Pembrokeshire Marine SAC condition assessment

Twaite shad has been designated as a qualifying feature in Pembrokeshire Marine SAC as it has been considered an important coastal migration route or feeding ground for this species. There are no known historical spawning grounds in the freshwater catchments which flow into the SAC. A summary of the condition assessment for twaite shad in Pembrokeshire Marine SAC can been seen in Table 6. The overall feature condition, a detailed summary of the assessment and threats to condition are discussed in more detail in the sections below.

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

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Population variables and data	The wider population of twaite shad relevant to the SAC should be stable or increasing in the long-term. (P)	• Data on twaite shad within the Pembrokeshire Marine SAC are very limited. • The population of twaite shad within the SAC are thought to migrate between spawning grounds in the Rivers Tywi, Severn, Wye and Usk and this marine SAC. Records of the species in these rivers and records within the marine SAC have therefore been considered in the assessment. • Monitoring and modelling of the River Severn populations (1991-2024) during the Unlocking the Severn project has found large reductions in the number of twaite shad returning to the River Severn. The indicator failed based on this declining population. Confidence was reduced as the relative contribution of each river population to the Pembrokeshire Marine SAC population is unknown. • Some angler data and limited egg counts indicate that the twaite shad population in the Tywi, Usk and Wye may be stable. The absence of population counts on these rivers reduced the confidence, leading to a low confidence.	**Fail**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Habitat connectivity	Maintain safe passage and movement of twaite shad in the marine environment into, within and away from the SAC. (P)	• There are no known barriers to marine migration within or into the Pembrokeshire Marine SAC. • There are no known barriers to migration in the Carmarthen Bay and Estuaries SAC and Severn Estuary SAC, and in the Bristol Channel that could impact twaite shad in the Pembrokeshire Marine SAC. • Confidence is high as in depth site knowledge was used.	**Pass**	High
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities is not having a detrimental impact at the population level. (P)	• There are no known records of the INNS that are of particular concern for twaite shad within Pembrokeshire Marine SAC. • Confidence is high due to the availability of long term monitoring data on the species of concern to twaite shad.	**Pass**	High
Anthropogenic mortality: targeted exploitation	There should be no targeted exploitation of the species. (S)	• No targeted exploitation of twaite shad is understood to be occurring. • Under the Wildlife & Countryside Act 1981 (as amended) it is illegal to fish for twaite shad without a license. • Confidence is high as the assessment was based on expert judgement and knowledge that there are no fisheries that could capture the species in the SAC.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Anthropogenic mortality: abstraction and entrapment	Abstraction and entrapment should not adversely affect the viability of the population. (S)	• All licenced abstractions have previously been assessed through the Habitats Regulations RoC process, Eel Regulations, or SAFFA 1975. • All new abstractions are required to go through permitting processes to comply with screening requirements for fish. • There has been no evidence of entrapment of twaite shad recorded at Pembroke Power Station. • There are no other major operations within the SAC known to be causing entrapment of twaite shad. • Confidence is high as all operations go through permitting processes and as the assessment has been based on up-to-date specialist knowledge and data.	**Pass**	High
Anthropogenic mortality: bycatch	Bycatch of the species should not adversely affect the viability of the population. (S)	• Bycatch of twaite shad is thought to be low for the SAC population. • Pelagic fisheries in the Celtic Sea may have bycatch of twaite shad but there are no data on the potential impact of this. • The indicator was assessed as unknown as there are no data to assess the extent and impact of bycatch of twaite shad.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• Four of the six WFD waterbodies in the SAC were not classified as the chemicals have not been assessed within the last six years (Pembrokeshire South, Cardigan Bay South, Grassholm Island and the Smalls, and Solfach Estuary). • One WFD waterbody has a fail for chemicals in the 2024 cycle 3 interim classification, due to polybrominated diphenyl ethers (PBDE) and polycyclic aromatic hydrocarbons (PAH) (Milford Haven Inner). • One WFD waterbody has a pass for chemicals (Milford Haven Outer). However, some of the chemical classifications were rolled forward from the 2021 cycle 3 classification. This waterbody has improved since previous cycles. • Twaite shad are likely to use the coastal areas of the SAC in migration routes, and are unlikely to spend a significant amount of time in the Milford Haven estuary as they do not migrate up the Cleddau Rivers. This indicator was therefore assessed as unknown as the coastal waterbodies have not been classified for this WFD element.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (P)	• Five of the six WFD waterbodies in the SAC have been classified as High status for dissolved oxygen in the 2024 cycle 3 interim classification. • All WFD waterbodies that have been assessed overlap with an extensive area within the SAC and are therefore considered to be representative of the area that twaite shad would use in the SAC. • Confidence is medium as samples have been taken from the surface of waterbodies.	**Pass**	Medium
Water quality: physicochemical properties	Maintain natural physicochemical properties of water subject to natural variation. (T)	• Data from intertidal and subtidal temperature loggers were available. Some temperature loggers in the SAC showed an increase in the number of days with higher temperatures, and potential step change in temperature. • Pembroke Power Station report indicated a localised increase in temperature, which was deemed unlikely to be of wider ecological significance. • This indicator was assessed as unknown due to a lack of understanding of the cause of the temperature patterns, and because there are currently insufficient data on other physicochemical parameters (e.g. salinity and pH).	**Unknown**	N/A

Assessment conclusions

The twaite shad feature in Pembrokeshire Marine SAC has been assessed as being in **unfavourable** condition (low confidence). There was one indicator with a failing target (Table 7). The confidence was reduced to low as the contribution of twaite shad from the Severn to the SAC population is unknown, and because the state of the twaite shad population in the Tywi, Usk and Wye are unknown but may be stable. Further investigation is needed to better understand the failure to be able to identify management options that can bring the feature back into favourable condition.

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

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

SAC	Overall Condition Assessment	Indicator failures	Reason for target failure	Threats to condition
Pembrokeshire Marine	**Unfavourable (low confidence)**	Population variables and data (P)	• The population of twaite shad in the Severn catchment is declining, which is likely to contribute to the Pembrokeshire Marine SAC population, and may be reflective of wider shad population trends.	• Industry • INNS • Water quality: contaminants • Climate change

Detailed assessment information

Population variables

There are no known historical twaite shad spawning grounds in the freshwater catchments directly upstream of the Pembrokeshire Marine SAC (Cleddau Rivers SAC). The historical population of twaite shad within the SAC are thought to migrate between spawning grounds in the Rivers Tywi and Severn (including the important tributaries, rivers Usk and Wye). As the SAC was designated for the species to use as a migration route, records of the species in the rivers that are thought to contribute to the SAC population and expert judgement of their potential use the marine SAC have been considered.

In the River Severn catchment, the population of twaite shad has been modelled from 1991 to 2024, and monitored as part of the Unlocking the Severn project. These have shown a significant decline in the number of returning adult shad (EA, 2020), with the current data indicating that there has been a decline to less than 10% of the pre-2017 adult population (EA, unpublished). The cause of this decline is unclear, and it is also not known whether it is a river-specific issue or is also occurring in the Rivers Wye, Usk and Tywi.

Good juvenile recruitment is heavily dependent on warm, stable flow conditions in the spawning rivers (Aprahamian et al., 2010; Knights, 2014). More extreme weather events such as flooding, especially in summer months, in the last 20 years may have limited the recruitment of twaite shad (EA, 2020). The current British population of twaite shad is substantially lower than it has been historically (Nunn et al., 2023). The spawning run estimates in the Severn Estuary have been considered to be appropriate to use as an index site to assess any changes in the population size regionally. These estimates found that the three-generation percentage change was approximately 41% (Nunn et al., 2023). NRW has records of shad eggs which show that shad are spawning on a regular basis in the relevant river catchments. However, it is not possible to determine what species the eggs are.

Historically, twaite shad ascended the Severn as far as Welshpool (Aprahamian et al., 1998). On the Severn, the Unlocking the Severn Project has constructed a series of fish passes that open up 254 km of previously inaccessible river to shad, greatly improving the area of available habitat on the river and allowing access along the main Severn as far as Stourport. However, this only amounts to approximately half the distance of river that would previously have been available. Barriers in the River Severn, and upstream tributaries in the Usk are still present and are thought to be limiting the upstream migration of shad within this catchment. Improvements are planned or in progress at the two weirs on the Usk to progress fish easement as part of the Four Rivers for LIFE project, and works have also been carried out on some of the weirs on the Severn in England as part of the Unlocking the Severn Project. The indicator linked to population was assessed as failing the set target due to the decline of twaite shad in the River Severn population. The contribution of this population into the Pembrokeshire Marine SAC population is not known.

There has been angler data from the Wye and Usk and egg counts in the three rivers (Tywi, Usk and Wye) which indicate that the population of twaite shad may be stable (NRW, in prep). However, quantification of the population size in these rivers has not been possible using the counter data available. This is because twaite shad migrate in shoals

and are therefore difficult to count, and as fish were found to move both up and downstream at the counter location. The lack of direct count data of the twaite shad populations in the Tywi, Usk and Wye reduced the confidence, leading to an overall low confidence assessment. Data on twaite shad in the Pembrokeshire Marine SAC are very limited and there have been no targeted surveys of the species in any of the marine SACs, therefore surveys of the species within the SAC are required.

Habitat connectivity

There are no known marine barriers from the Severn Estuary SAC and Carmarthen Bay and Estuaries SAC, and along the coast and in the Bristol Channel that could impact twaite shad in the Pembrokeshire Marine SAC. The indicator therefore passed its target with high confidence as there are no known issues with connectivity within the marine migration routes into and through the SAC.

The freshwater flow indicator is not applicable as there are no known spawning populations of twaite shad in the freshwater catchments.

Invasive non-native species

The INNS that could significantly impact the twaite shad are Chinese mitten crab and Signal crayfish. There have been no known records of these species within the Pembrokeshire Marine SAC, however, there has been no targeted monitoring of Chinese mitten crab within the area. The INNS indicator therefore passed the target with a high confidence.

Anthropogenic mortality

There is no known targeted exploitation of twaite shad within Pembrokeshire Marine SAC therefore this indicator passed its target. Under the Wildlife & Countryside Act 1981 (as amended) it is illegal to fish for twaite shad without a license. Any specimens caught unintentionally must be released alive. High confidence was attributed to the indicator pass as it was based on expert judgement and knowledge that there are no fisheries that could capture the species in the site.

In Wales, all licenced abstractions have been assessed through Habitats Regulations RoC process, Eel Regulations, or SAFFA 1975 to ensure that all permitted abstractions are screened to minimise entrainment of fish. Pembroke Power Station abstracts water from the SAC. Annual impingement and entrainment monitoring is conducted at the power station has not recorded any twaite shad since the commencement of operation (RWE, unpublished data). The power station may pose a threat due to the abstraction and possibility of entrainment or impingement, but monitoring suggests no current impacts to the species. Therefore, it has been identified as not posing a significant impact to twaite shad. There are no other major operations within the Pembrokeshire Marine SAC known to be causing entrapment of twaite shad. The abstraction and entrapment target was therefore assessed as passing with high confidence as all operations go through regulated screening permitting processes and as the assessment has been based on up-to-date specialist knowledge and data.

Bycatch of twaite shad within the Pembrokeshire Marine SAC is thought to be low. There may be some bycatch of twaite shad in the pelagic fisheries in the Celtic Sea, however there are no data on the potential impact of this on the SAC population. As there are no data to assess the extent and impact of bycatch of twaite shad, the indicator was assessed as unknown.

Water quality

See allis shad water quality in section 3.1 as it also applies to twaite shad.

Reasons for target failure

The assessment of twaite shad in Pembrokeshire Marine SAC failed one primary target. This resulted the twaite shad feature to be assessed as being in **unfavourable** condition. The failing indicator and reasons for failure, if known, are stated below.

Population variables and data

The historical population of twaite shad in the Pembrokeshire Marine SAC migrate between the Usk, Wye, Severn and Tywi populations, as there has never been a known population of twaite shad in the Cleddau Rivers. Modelling and recent monitoring of twaite shad in the Severn catchment using data from the putcher ranks sampling, Hinkley Point B impingement records and Unlocking the Severn run counts depict a long-term decline of twaite shad. The long-term decline is likely linked to an increase in more extreme weather events, such as summer flooding, which limits the recruitment of twaite shad (EA, 2020). The condition of the twaite shad population in the Tywi, Usk and Wye may be stable.

Threats to condition

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

Industry

Any planned installations and projects which could impinge or entrap twaite shad, and therefore have the potential to impact the species at a population level, need to be considered carefully, given the low population levels.

Invasive non-native species

There are currently no records of Chinese mitten crab in the Pembrokeshire Marine SAC. There is a threat that these could be introduced to the area.

Further INNS were identified as potential threats to the UK and were listed in the latest horizon scanning exercise (Roy et al., 2019). There is a high likelihood for some of these species to be found in Wales in the future. This SAC could be at risk since there are a

number of possible pathways of introduction. Further information on introduction pathways can be found on the GB non-native species secretariat website.

Water quality: contaminants

At the time of the assessment, twaite shad are thought not to be adversely impacted by contaminants at the population level. There is the potential for unregulated contaminants (such as PFAS) to increase. This could affect twaite shad as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

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

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counteract each other. However, threats from climate change that could impact the species may include:

- Increasing sea surface and river temperature.
- Changes to prey availability and abundance.

4.2. Carmarthen Bay and Estuaries SAC condition assessment

Twaite shad has been designated as a qualifying feature in the Carmarthen Bay and Estuaries SAC. Twaite shad migrate through the Carmarthen Bay and Estuaries SAC to reach spawning sites in the River Tywi SAC, and are likely to use the inshore coastal waters of Carmarthen Bay for feeding, and the Three Rivers estuary for nursery areas. Populations from other regions (Rivers Severn, Wye and Usk) have also been considered in the assessment as they are likely to contribute to the Carmarthen Bay and Estuaries SAC population of twaite shad. There may be other relevant rivers that contribute to the SAC population. A summary of the condition assessment for twaite shad in Carmarthen Bay and Estuaries SAC can been seen in Table 8. The overall feature condition, a detailed summary of the assessment and threats to condition are discussed in more detail in the sections below.

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

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Population variables and data	The population of twaite shad relevant to the SAC should be stable or increasing in the long-term. (P)	• The population size of twaite shad in the River Tywi catchment is unknown. However, there has been anecdotal evidence of spawning in the catchment and populations were thought to be strong in 2023. • Telemetry studies evidence that twaite shad from the Rivers Severn, Wye and Tywi use embayment's such as Bridgwater Bay and Swansea Bay. These have therefore been considered in the assessment. Modelling of River Severn populations (1991-2023) showed large reductions in the number of twaite shad returning. The indicator failed the target based on this declining population. • Confidence is low as the contribution of each river population into the SAC is unknown and as some angler data and limited egg counts indicate that the twaite shad population in the Tywi, Usk and Wye may be stable. The absence of population counts on these rivers reduced the confidence.	**Fail**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Habitat connectivity	Maintain safe passage and movement of twaite shad in the marine environment into, within and away from the SAC, including to and from the connected spawning locations. (P)	• There are no known barriers to marine migration within or into the Carmarthen Bay and Estuaries SAC. • There are no known barriers to migration in the Severn Estuary SAC and in the Bristol Channel that could impact twaite shad in the Carmarthen Bay and Estuaries SAC. • Confidence is high as in depth site knowledge was used.	**Pass**	High
Freshwater flow	Maintain freshwater flow to the estuary / estuaries within the SAC. Regulated rivers meet their minimum flow targets. (P)	• There are no known issues affecting the freshwater flow to the Carmarthen Bay and Estuaries SAC that would affect twaite shad migration. • There are no known issues within the River Tywi SAC catchment affecting flow to the Three Rivers estuary. • Licenced abstractions on the River Tywi SAC have gone through the RoC process ensure designated features are adequately protected. • Flow data were not analysed for this assessment therefore confidence is medium.	**Pass**	Medium
Invasive non-native species (INNS)	Spread and impact of INNS caused by human activities is not having a detrimental impact at the population level. (P)	• There are no known records of the INNS that are of particular concern for twaite shad within Carmarthen Bay and Estuaries SAC and associated River Tywi SAC. • Confidence is high due to the availability of long term monitoring data on the species of concern to twaite shad.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Anthropogenic mortality: targeted exploitation	There should be no targeted exploitation of the species. (S)	• No targeted exploitation of twaite shad is understood to be occurring. • Under the Wildlife & Countryside Act 1981 (as amended) it is illegal to fish for twaite shad without a license. • Confidence is high as the assessment was based on expert judgement and knowledge that there are no fisheries that could capture the species in the SAC.	**Pass**	High
Anthropogenic mortality: abstraction and entrapment	Abstraction and entrapment should not adversely affect the viability of the population. (S)	• All licenced abstractions have previously been assessed through the Habitats Regulations RoC process, Eel Regulations, or SAFFA 1975. • All new abstractions are required to go through permitting processes to comply with screening requirements for fish. • There are no major operations within the SAC or rivers draining into the SAC known to be causing entrapment of twaite shad. • Confidence is high as all operations go through permitting processes and as the assessment has been based on up-to-date specialist knowledge and data.	**Pass**	High
Anthropogenic mortality: bycatch	Bycatch of the species should not adversely affect the viability of the population. (S)	• Bycatch of twaite shad is thought to be low for the SAC population. • Pelagic fisheries in the Celtic Sea may have bycatch of twaite shad but there are no data on the potential impact of this. • The indicator was assessed as unknown as there are no data to assess the extent and impact of bycatch of twaite shad.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Fish Community	The WFD Estuarine Fish tool is at least good. (T)	• The estuarine fish WFD element is assessed in transitional WFD waterbodies only. • Neither of the two transitional WFD waterbodies in the SAC (Burry Inlet Inner and Three Rivers Estuary) were assessed for the estuarine fish WFD element in the 2024 cycle 3 interim classification. • The indicator was therefore assessed as unknown.	**Unknown**	N/A
Water quality: contaminants	Water column contaminants not to exceed the EQS. (S)	• Three of the four WFD waterbodies in the SAC have a pass for chemicals in the 2024 cycle 3 interim classification Burry Inlet Inner, Burry Inlet Outer and Three Rivers Estuary). In all waterbodies, some or all of the chemical classifications were rolled forward from previous cycles as they were not classified in the 2024 cycle 3 interim classification. • The other WFD waterbody has a fail for chemicals (Carmarthen Bay). It failed for mercury, PBDE and cypermethrin. • Confidence is low as: the human health standard has been used for PBDE; some chemical classifications have been rolled forward; and contaminants are not directly monitored in this species.	**Fail**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water quality: dissolved oxygen	The WFD classification achieved for dissolved oxygen should be Good or High status in WFD waterbodies that overlap with the feature, and there should be no deterioration between status classes. (P)	• All four WFD waterbodies in the SAC have been classified as High status for dissolved oxygen in the 2024 cycle 3 interim classification. • All WFD waterbodies that have been assessed overlap with an extensive area within the SAC and are therefore considered to be representative of the area that twaite shad would use in the SAC. • Confidence is medium as samples have been taken from the surface of waterbodies.	**Pass**	Medium

Assessment conclusions

The twaite shad feature in Carmarthen Bay and Estuaries SAC has been assessed as being in **unfavourable** condition (low confidence). There were two indicators with failing targets (Table 9). The confidence was reduced to low as the contribution of twaite shad from the Severn to the SAC population is unknown, and because the state of the twaite shad population in the Tywi, Usk and Wye are unknown but may be stable. Further investigation is needed to better understand the failure to be able to identify management options that can bring the feature back into favourable condition.

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

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

SAC	Overall Condition Assessment	Indicator failures	Reason for target failure	Threats to condition
Carmarthen Bay and Estuaries	**Unfavourable (low confidence)**	Population variables and data (P) Water quality: contaminants (S)	• The population of twaite shad in the Severn catchment is declining, which is likely to contribute to the Carmarthen Bay and Estuaries SAC population, and may be reflective of wider shad population trends. • Levels of mercury, PBDE and cypermethrin in the Carmarthen Bay waterbody are failing to meet their relevant EQSs.	• Industry • INNS • Water quality: contaminants • Climate change

Detailed assessment information

Population variables

The River Tywi is one of the only three rivers in Wales where there are substantial spawning populations of shad. It should be noted that the shad population on the Tywi shows an unusually high proportion of allis shad haplotypes (72%), likely indicating past hybridisation with allis shad (Hardouin et al., 2013). For the purposes of these assessments, these individuals are considered to be twaite shad as allis shad numbers are very low across Wales.

The River Tywi is the main contributing river to the Carmarthen Bay and Estuaries SAC population of twaite shad. There has been anecdotal evidence of twaite shad spawning throughout the River Tywi catchment below Llandeilo, and it is reasonably certain that populations were strong in 2023. However, quantification of the population size in the River Tywi has not been possible using the counter data available. This is because twaite shad migrate in shoals and are therefore difficult to count, and as fish were found to move both up and downstream at the counter location.

Shad telemetry studies conducted by Swansea University have provided evidence of movements of twaite shad from the Severn, Wye and Tywi within the Bristol Channel. Shad from all these rivers have been shown to utilise embayment's such as Bridgwater Bay and Swansea Bay within the Bristol Channel at different points during the year, with a significant degree of mixing within the Bristol Channel. Therefore, it is likely that twaite shad from the Usk, Wye and Severn use the Carmarthen Bay and Estuaries SAC. Records of the species in the River Severn and its tributaries have therefore been considered in the assessment.

Modelling of twaite shad in the River Severn catchment from 1991 to 2023 showed a significant decline in the number of returning adult shad (see section 4.1 for further information).

The River Tywi twaite shad population was surveyed in 2013 and 2015 using egg surveys (a measure of spawning extent). On these occasions, the Tywi met its target (Garrett, 2015). No comparable surveys are available for the Usk and Wye.

The indicator linked to population was assessed as failing the set target due to the decline of twaite shad in the River Severn population. The contribution of this population into the Carmarthen Bay and Estuaries SAC population is not known, and it is not certain if the declines seen in the Severn are due to localised impacts or broader effects such as more extreme weather events which are likely to affect other rivers as well. There has been angler data from the Wye and Usk and egg counts in the three rivers (Tywi, Usk and Wye) which indicate that the population of twaite shad may be stable (NRW, in prep). However, quantification of the population size in these rivers has not been possible using the counter data available. This reduced the confidence, leading to an overall low confidence assessment. Data on twaite shad in the Carmarthen Bay and Estuaries SAC are very limited and there have been no targeted surveys of the species in any of the marine SACs.

Habitat connectivity and freshwater flow

There are no known marine barriers in the Carmarthen Bay and Estuaries SAC and from the Severn Estuary SAC, and along the coast in between that could impact twaite shad in the Carmarthen Bay and Estuaries SAC. The indicator therefore passed its target with high confidence as there are no known issues with connectivity within the marine migration routes into and through the SAC.

The freshwater flow indicator passed its target as there are no known issues with flow to the Three Rivers estuary or River Tywi SAC that drains directly into the Carmarthen Bay and Estuaries SAC. This conclusion was based on the RoC process (see further information in section 3.1). Confidence in the pass is medium as flow data were not used for the assessment.

Invasive non-native species

The INNS that could significantly impact the twaite shad are Chinese mitten crab and Signal crayfish. There are no known records of these species within the Carmarthen Bay and Estuaries SAC nor the River Tywi SAC catchment. There have been a very small number of records of Signal crayfish in the Usk management catchment, but these are unlikely to be affecting twaite shad at the population level. The INNS indicator therefore passed its target with a high confidence.

Anthropogenic mortality

There is no known targeted exploitation of twaite shad within Carmarthen Bay and Estuaries SAC therefore this indicator passed its target. Under the Wildlife & Countryside Act 1981 (as amended) it is illegal to fish for twaite shad without a license. Any specimens caught unintentionally must be released alive. High confidence was attributed to the indicator pass as it was based on expert judgement and knowledge that there are no fisheries that could capture the species in the site.

In Wales, all licenced abstractions have been assessed through Habitats Regulations RoC process, Eel Regulations, or SAFFA 1975 to ensure that all permitted abstractions are screened to minimise entrainment of fish. There are no major operations such as power stations within the Carmarthen Bay and Estuaries SAC or rivers draining into the SAC known to be causing entrapment of twaite shad. The abstraction and entrapment target was therefore assessed as passing with high confidence as all operations go through regulated screening permitting processes and as the assessment has been based on up-to-date specialist knowledge and data. There were power stations in the Bristol channel which are no longer operational, and abstraction has significantly reduced therefore they are no longer considered a threat to twaite shad.

Bycatch of twaite shad within the Carmarthen Bay and Estuaries SAC is thought to be low. There may be some bycatch of twaite shad in the pelagic fisheries in the Celtic Sea, however there are no data on the potential impact of this on the SAC population. As there are no data to assess the extent and impact of bycatch of twaite shad, the indicator was assessed as unknown.

Fish community

The fish community indicator was assessed as unknown for twaite shad in the Carmarthen Bay and Estuaries SAC due to an absence of data. The estuarine WFD fish tool is used as a proxy for habitat quality in the estuaries. If this element is classified as Good status it is likely that the conditions for fish, and therefore twaite shad, are favourable. The estuarine fish element is assessed in the transitional WFD waterbodies only. Within the SAC there are two transitional WFD waterbodies, the Burry Inlet Inner and Three Rivers Estuary waterbodies, and neither has been assessed in the 2024 cycle 3 interim classification. The Three Rivers Estuary waterbody was previously assessed with a Moderate status in the 2009 cycle 1 classification but it has not been assessed since. The methodology used in the WFD fish classification has changed since the 2009 cycle 1 classification. As the cycle 1 information is not comparable to the current methodology, it has not be used.

Water quality

See allis shad water quality in section 3.2 as it also applies to twaite shad.

Reasons for target failure

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

Population variables and data

Twaite shad migrate between the Carmarthen Bay and Estuaries SAC and spawning rivers directly upstream in the Tywi, and also between the Usk, Wye and Severn. However, the degree of the contributions of these other spawning rivers to the SAC population is not fully understood. Modelling and recent monitoring of twaite shad in the Severn catchment using data from the putcher ranks sampling, Hinkley Point B impingement records and Unlocking the Severn run counts depict a long-term decline of twaite shad. The Unlocking the Severn monitoring has shown a further significant reduction in the population since 2020. The long-term decline is likely linked to an increase in more extreme weather events, such as summer flooding (EA, 2020). The condition of the twaite shad population in the Tywi, Usk and Wye may be stable.

Water quality: contaminants

See allis shad reasons for failure in section 3.2 as it also applies to twaite shad.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the twaite shad feature. A threat is defined as an activity that is currently not impacting condition but has the potential to do so over the next reporting cycle, if activity levels increase or are unmanaged. It is important to identify these threats to be able to put pre-emptive

management in place to prevent declines in condition. The threats to the twaite shad feature in Carmarthen Bay and Estuaries SAC are stated below.

Industry

Any planned installations and projects which could impinge or entrap twaite shad, and therefore have the potential to impact the species at a population level, need to be considered carefully, given the low population levels.

Invasive non-native species

There have been a very small number of records of Signal crayfish in the Usk management catchment, but these are unlikely to be affecting twaite shad at the population level. There are currently no records of Chinese mitten crab in the Carmarthen Bay and Estuaries or River Tywi SACs. There is a threat that these could be introduced to the area.

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

Water quality: contaminants

At the time of the assessment, twaite shad are thought not to be adversely impacted by contaminants at the population level. There is the potential for unregulated contaminants (such as PFAS) to increase. This could affect twaite shad as PFAS has been shown to bioaccumulate in marine species, increasing up the trophic levels (Khan et al., 2023). However, the biological impact of PFAS on marine species is not well understood.

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

Climate change

It is not yet clear what pressures we will see from climate change at the SAC level or how different pressures will counteract each other. However, threats from climate change that could impact the species may include:

- Increasing sea surface and river temperature.
- Changes in precipitation impacting riverine flow in spring and summer, affecting the ability of adults to pass partial barriers and causing washout of eggs and juveniles.
- Changes to prey availability and abundance.

5. Evidence gaps for the allis and twaite shad features

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

Listed below are current indicators that were either assessed as unknown, not assessed, or assessed with a lower confidence. This was due to either limited data availability, outdated data, or a lack of information. Some indicators are not currently monitored but should be ideally considered in future condition assessments. Not all evidence gaps apply to every SAC, see Table 10 for details.

Table 10. Evidence gaps for the allis and twaite shad features in Welsh SACs. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see section 1.1).

Indicator	Assessed status	Comments
Population variables and data (P)	Low or medium confidence (limited data)	• Although this indicator was assessed in both SACs, data on allis shad in the marine environment are limited and there have been no targeted surveys of the species within the marine SACs. Similarly, data on twaite shad in the Tywi, Usk and Wye are limited, and there have been no targeted surveys of the species within the marine SACs.
Anthropogenic mortality: bycatch (S)	Unknown	• The extent of bycatch of allis and twaite shad in fisheries is uncertain.
Fish community (S)	Unknown	• The WFD Regulations monitoring of the estuarine fish community element is only carried out in some transitional WFD waterbodies therefore this does not cover the full extent of the SACs (coastal WFD waterbodies). • In the Carmarthen Bay and Estuaries SAC, neither of the transitional WFD waterbodies have been assessed for the estuarine fish element in the 2024 cycle 3 interim classification. • This indicator is not applicable to the Pembrokeshire Marine SAC as the allis and twaite shad are not thought to spend a significant amount of time in the transitional WFD waterbody in the SAC.

Indicator	Assessed status	Comments
Water quality: physicochemical properties (T)	Not assessed / unknown	• There were no temperature, salinity or pH loggers within the Carmarthen Bay and Estuaries SAC. • Further evidence in temperature changes is required to adequately assess this indicator in the Pembrokeshire Marine SAC. • Some physicochemical parameters such as salinity and pH have not been assessed in any SAC. These could be considered in future as some monitoring data are available. Remote sensing data on temperature, salinity and pH could be used in future.

References

Aprahamian, M.W., Lester, S.M., and Aprahamian, C.D. 1998. Shad Conservation in England and Wales. Environment Agency Technical Report W110. Environment Agency, Warrington.

Aprahamian, M.W., Aprahamian, C.D., Baglinière, J.L., Sabatié, R. and Alexandrino, P. 2003. *Alosa alosa* and *Alosa fallax* spp. Literature Review and Bibliography. Environment Agency. R&D Technical Report W1-014/TR

Aprahamian, M.W., Aprahamian, C.D., and Knights, A.M. 2010. Climate change and the green energy paradox: the consequences for twaite shad *Alosa fallax* from the River Severn, U.K. *Journal of Fish Biology*, 77: 1912-1930.

Environment Agency. 2019. Cypermethrin: Sources, pathways and environmental data.

Environment Agency. 2020. Hinkley Point C Permit Variation EPR/HP3228XT/V004. Technical Brief: TB016: Review of adult run size estimates for Twaite Shad and Allis Shad in the Severn Estuary, River Wye and River Usk.

Franconi, N., Clarke, D., Blow, G., Davies, C., Gwilliam, M. and Rees, C. 2023. Understanding the distribution and survival of Twaite shad at sea. Swansea University.

Garrett, H. 2015. Afon Tywi SAC shad spawning assessment 2015 *(Alosa alosa & Alosa fallax),* incorporating classification of 2013 and 2014 survey data. NRW Evidence report no 87. 29pp, Natural Resources Wales, Bangor.

Hardouin, E.A., Stuart, S. and Andreou, D. 2013. Monitoring Allis and Twaite Shad: quality assurance and species identification using molecular techniques. NRW Evidence Report No: 1, 41pp, Natural Resources Wales, Bangor.

Khan, B., Burgess, R.M. and Cantwell, M.G., 2023. Occurrence and bioaccumulation patterns of per-and polyfluoroalkyl substances (PFAS) in the marine environment. *American Chemical Society, Environmental Science and Technology: Water*, 3(5), pp.1243-1259.

Knights, A.M. 2014. Modelling the response of the twaite shad (*Alosa fallax*) population in the Afon Tywi SAC to a modified temperature regime. pp. 48, Bangor.

Larsen, M. and Hjermann, D. 2022. Status and Trend for Heavy Metals (Mercury, Cadmium and Lead) in Fish, Shellfish and Sediment. In: OSPAR, 2023: The 2023 Quality Status Report for the Northeast Atlantic. OSPAR Commission, London.

Nunn, A.D., Ainsworth, R.F., Walton, S., Bean, C.W., Hatton-Ellis, T.W., Brown, A., Evans, R., Atterborne, A., Ottewell, D. and Noble, R.A.A. 2023. Extinction risks and threats facing the freshwater fishes of Britain. *Aquatic Conservation: Marine and Freshwater Ecosystems,* 33, 1460-1476.

NRW. In prep. Supporting documentation for the conservation status assessment for the species: S1103 Twaite shad (*Alosa fallax*) within 2025 Habitats Regulations 9A reporting for Wales. Natural Resources Wales. Available to download from NRW January 2026.

Roy, H.E., Peyton, J. and Rorke, S. 2019. Horizon-scanning for invasive alien species with the potential to threaten biodiversity and ecosystems, human health and economies in Britain. GB Non-native species secretariat.

Sutton, P. 2023. Analysis of 2020 and 2021 Milford Haven Temperature Monitoring Data Prepared for: Pembroke Power Station. RWE Generation UK plc. Reference number: ENV/713/2023

Viñas, L., Soerensen, A.L. and Fryer, R. 2022. Status and Trends of Polybrominated Diphenyl Ethers (PBDEs) in Biota and Sediment. In: OSPAR, 2023: The 2023 Quality Status Report for the North-East Atlantic. OSPAR Commission, London.