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Condition Assessments for Bottlenose Dolphin *Tursiops truncatus* in Welsh Special Areas of Conservation

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Bottlenose Dolphin *Tursiops truncatus*, © Peter Evans.

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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 dolffin trwyn potel *Tursiops truncatus* 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 dolffin trwyn potel mewn ACAau ledled Cymru

Lleoliad y nodwedd ACA	Asesiad cyflwr	Hyder yn yr asesiad
Bae Ceredigion	Ffafriol	Canolig
Pen Llŷn a'r Sarnau	Ffafriol	Isel

Executive summary

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

This evidence report, which was delivered as part of the Welsh Government funded improving marine conservation advice (IMCA) project, presents the findings of NRW's condition assessments for bottlenose dolphin *Tursiops truncatus* within designated special areas of conservation (SACs) across Wales. Section 1 gives an overview of the assessment process and Section 2 provides a description and location of the feature.

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 bottlenose dolphin in SACs across Wales.

SAC feature occurs in	Condition assessment	Confidence in assessment
Cardigan Bay	Favourable	Medium
Lleyn Peninsula and the Sarnau	Favourable	Low

1. Introduction

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

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

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

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., an estuary 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

The following text is adapted from the species description from the JNCC list of Annex II Vertebrate species: mammals.

The bottlenose dolphin *Tursiops truncatus* is a large dolphin species and around the UK and northern Europe they are considerably larger than individuals of the same species in most parts of the world, reaching up to around 4 m in length, although 2.5-2.7 m is a more usual adult length. In the UK there are two distinct forms (ecotypes) - a wide-ranging offshore type, and an inshore or coastal type, more likely to be site/area faithful (Louis et al., 2014). Around Wales, the species is primarily coastal, with most sightings within 10 km of land, but individuals can also range further offshore especially during the winter months. The offshore ecotype occur in large aggregations of many hundreds of individuals particularly off the Atlantic coast of Ireland, but single animals or small groups of up to 25 animals are sighted elsewhere. They may occur in association with other cetaceans.

A small number of semi-resident inshore / coastal populations are known in the UK, the largest of which is centred upon Cardigan Bay in west Wales. The two SACs in Cardigan Bay are designated primarily for this coastal bottlenose dolphin population.

More information on bottlenose dolphin can be found on the JNCCs website.

3. Bottlenose dolphin *Tursiops truncatus* condition assessments

This section contains assessments for bottlenose dolphin in Welsh only special areas of conservation (SAC). The feature is designated in two SACs in Wales (Figure 1):

- Bae Ceredigion / Cardigan Bay
- Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau

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

Bottlenose dolphin condition in these SACs has been assessed against the chosen performance indicators. Any gaps in evidence that would improve the assessment of condition have been identified for each SAC (Section 5).

The indicators were assessed using a combination of information from NRW monitoring, commissioned evidence reports, Water Framework Directive (WFD) Regulations 2017 (WFD Regulations) monitoring, scientific literature, plan and project assessments, site knowledge and expert judgement. The outcome and any reasons for failure for each SAC are discussed in more detail in the sections below.

Each bottlenose dolphin condition assessment is a standalone report that can be read independently. However, as bottlenose dolphins are a mobile species and move between the SACs, at times the same sources of data have been used to assess each site, resulting in some repetition across the assessments. Where the assessment is the same across both SACs, reference will be made to the Cardigan Bay assessment as it is the principal site for bottlenose dolphin in Wales.

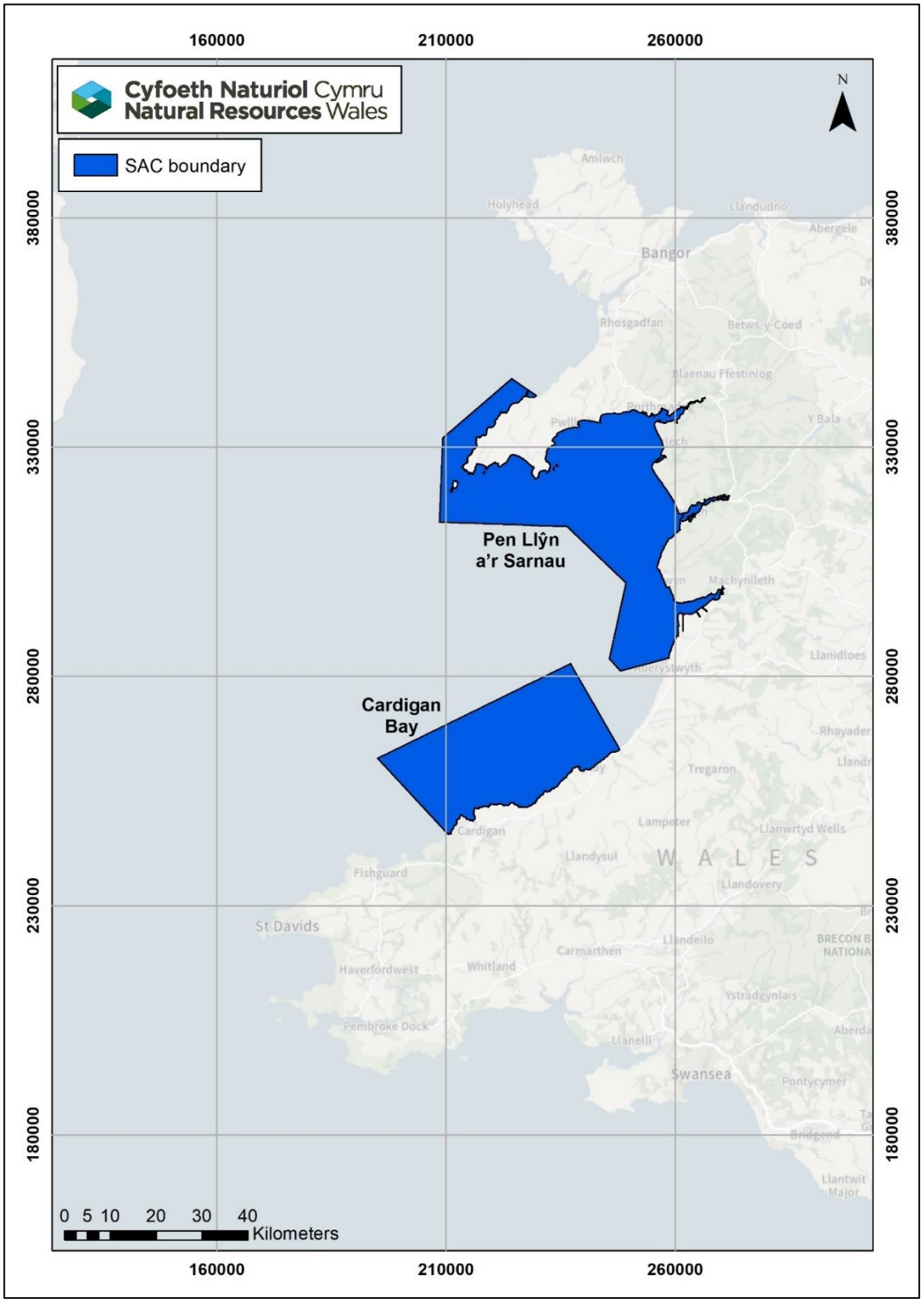
In these condition assessments, the WFD 2024 cycle 3 interim classification was the default information used for water quality, however other earlier cycles were referenced, as follows:

- 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 bottlenose dolphin feature.



3.1. Cardigan Bay SAC condition assessment

Monitoring of the bottlenose dolphin *Tursiops truncatus* population in Cardigan Bay SAC began in 2001 using a combination of photo ID and boat based transect surveys. A summary of the condition assessment can be seen in Table 2. The assessment conclusion, a detailed summary of the assessment and any reasons for failure can be found in the sections below.

Table 2. Condition assessment of bottlenose dolphin in Cardigan Bay 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 size: Number of bottlenose dolphins using the SAC in the long term	A stable or increasing number of bottlenose dolphins using the SAC over the long term, allowing for natural change and variation. (P)	• Long term is defined as 20 years or more. • The bottlenose dolphins in the Cardigan Bay SAC are part of the larger population residing in the whole of Cardigan Bay and the Irish Sea Management Unit. • The population using the SAC has fluctuated over the monitored period (2001 - 2024). However, the population has been stable over the long term. • Confidence in the pass is high due to quality of the long term data set in the SAC.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Population size: Number of bottlenose dolphins using the SAC in the short term	A stable or increasing number of bottlenose dolphins using the SAC over the short term, allowing for natural change and variation. (P)	• Short term is defined as five years or less. • There are some gaps in monitoring in the last five years for line transect derived estimates in the SAC and all methods in the wider Cardigan Bay region. However, apart from 2020 (Covid), there is a complete dataset for the SAC using Capture Mark Recapture (CMR) methods, which we consider to be the most relevant for this indicator. • Overall, abundance estimates of bottlenose dolphins appear to show an increase in recent years (short term). • The confidence in the pass is high due to the high quality data set.	**Pass**	High
Reproductive success: crude birth rate.	A stable or increasing crude birth rate over the short term, allowing for natural change and variation. (S)	• Crude birth rate is a measure of the proportion of newborns in the population • Crude birth rate data shows large inter annual variation over the monitoring period but seems to follow a pattern; years with a high crude birth rates (baby booms) are followed by a couple of years of low rates. • Data over the short term (five years) seem to be following this same pattern but appear to be lower when compared to the long term data series, and when compared to other coastal bottlenose dolphin populations. This warrants further investigation. • Confidence in the fail is low due to the difficulty in collecting birth rate data accurately, small sample size of mother-calf pairs as well as whether the change is part of a natural cycle. Further data and analyses are required.	**Fail**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Reproductive success: calf survival	Calf survival in each of their first 3 years should be no less than 80%, allowing for natural change and variation. (S)	• Bottlenose dolphin calves that survive to their 4th year are considered to be independent. • Data from the wider Cardigan Bay show the proportion of calves surviving to three years old (i.e. their 4th year) fluctuates annually but with no significant trend. • When comparing recent values to those from previous reports, the ratios are similar. • From 2001 to 2019 (latest available analyses), average calf survival for the population in each assessment year was: 1st year (0-1 year old) = 87%, 2nd year (1-2 years old) = 80%, and 3rd year (2-3 years old) = 92% • Confidence is low due to the lack of recent data and the inherently difficult nature of studying this indicator.	**Pass**	Low
SAC Residency	No significant decline in the proportion of the dolphin population considered to be resident to the SAC, allowing for natural change and variation. (P)	• Monitoring data indicate the proportion of residents is stable. • Based on long term monitoring the residency should remain above 35%. • CMR evidence shows net movement outside of the SAC fluctuates over the years. • Based on the latest data the population resident to Cardigan Bay SAC is around 37%. • Confidence in the pass is high due to the high-quality data for SAC monitoring.	**Pass**	High

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Accessibility to habitat used by bottlenose dolphins	No evidence of significant anthropogenic constraints on access of bottlenose dolphin using the SAC to necessary habitat within or associated with the site. (S)	• There is some evidence of both short and long-term negative relationships with recreational activities in Cardigan Bay SAC, therefore any unregulated increase in tourism could lead to bottlenose dolphins avoiding the area in the future • Marine developments are routinely assessed for impacts to bottlenose dolphins, but such developments are largely absent at present from Cardigan Bay and so are not likely to be limiting access to habitat. • There is currently no compelling evidence that bottlenose dolphins are avoiding any areas of necessary habitat due to anthropogenic drivers and are thus not being significantly constrained in accessing necessary habitats. • Confidence is low due to uncertainties around the population level impacts that activities have on bottlenose dolphins and the difficulty in defining when accessibility has been constrained. • This indicator has been assessed primarily on expert judgment which also impacted the confidence.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Anthropogenic disturbance	No significant anthropogenic disturbance affecting the bottlenose dolphin population associated with the SAC. (S)	• There is some evidence of both short and long-term negative relationships with recreational activities in Cardigan Bay SAC. Compliance with marine codes of conduct is generally good, although improvements are needed for compliance from some users. • It is known that some disturbance is occurring to bottlenose dolphin in the SAC through recreational boat use, but the extent and consequences are currently not well understood. • Marine developments are routinely assessed for disturbance impacts to bottlenose dolphins, but such developments are largely absent at present from Cardigan Bay. • However, while anthropogenic disturbance can have consequences such as adverse behavioural reactions even if it does not reach the level of resulting in displacement from an area, there is a lack of understanding on the population level impact. • Therefore this indicator has been assessed as unknown.	**Unknown**	N/A

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Water, sediment and prey contaminants	Ensure water, sediment and prey contaminants are at levels not detrimental to the bottlenose dolphin population. (S)	• The Cardigan Bay Central waterbody failed for chemicals (mercury and PBDE) in the 2024 cycle 3 interim classification. • OSPAR report that mercury and lead are above ecological guidelines in the North East Atlantic region, as is one congener of PCB. • OSPAR report that the PCB range in 2010-2020 was lower than the 1980s but still above marine mammal toxicity thresholds. • A study of marine mammals found that 80% of stranded bottlenose dolphins were above toxicity thresholds for PCBs. Several of these were found in Welsh waters. • PCBs are at levels that would be expected to have a physiological impact on bottlenose dolphins. Birth rates are low in recent years, but it is not possible to attribute this to PCBs. • As the population is stable and both mercury and PBDE are being managed, contaminants are deemed not to be having a detrimental impact on bottlenose dolphins at present. • Confidence is low as the impact of the levels of contaminants on the bottlenose dolphin population using the SAC is not clear.	**Pass**	Low

Indicator	Target	Assessment rationale	Target assessment	Target confidence
Prey availability	Maintain the quality, abundance and diversity of prey species needed to support the bottlenose dolphin population. (S)	• Bottlenose dolphin feed on a wide variety of prey. • The population is stable in the long term with a slight increase in recent years, suggesting prey is, at least in part, not limiting population growth. • There is insufficient evidence to suggest that bottlenose dolphins are prey limited or that there has been a reduction in the diversity or abundance of available species. However, changes in habitat use and the decline in birth rates could indicate the population may be adapting to a change in resource availability • Confidence in the pass is low due to the potential link between prey availability and declining birth rate, the presence of several depleted fish stocks in the region and as the assessment is based largely on expert judgement.	**Pass**	Low

Assessment conclusions

Bottlenose dolphin in Cardigan Bay SAC have been assessed to be in **favourable** condition (medium confidence). Overall the stable population of bottlenose dolphins using the SAC in the long and short term as well as no significant evidence of reduction in habitat quality led to the favourable assessment. However, one indicator with a secondary target failed due to an apparent decline in birth rate (Table 3). One indicator was also assessed as unknown. This reduced the confidence in the overall favourable assessment to medium. Further investigation is required to see why the crude birth rate is in decline. See Section 4 for more information on threats to condition.

Table 3. Condition assessment summary for bottlenose dolphin in Cardigan Bay SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Cardigan Bay	**Favourable (medium confidence)**	Reproductive success: crude birth rate (S)	• Declining crude birth rates in the short term.	• Recreational disturbance • Contaminants • Prey availability

Detailed assessment information

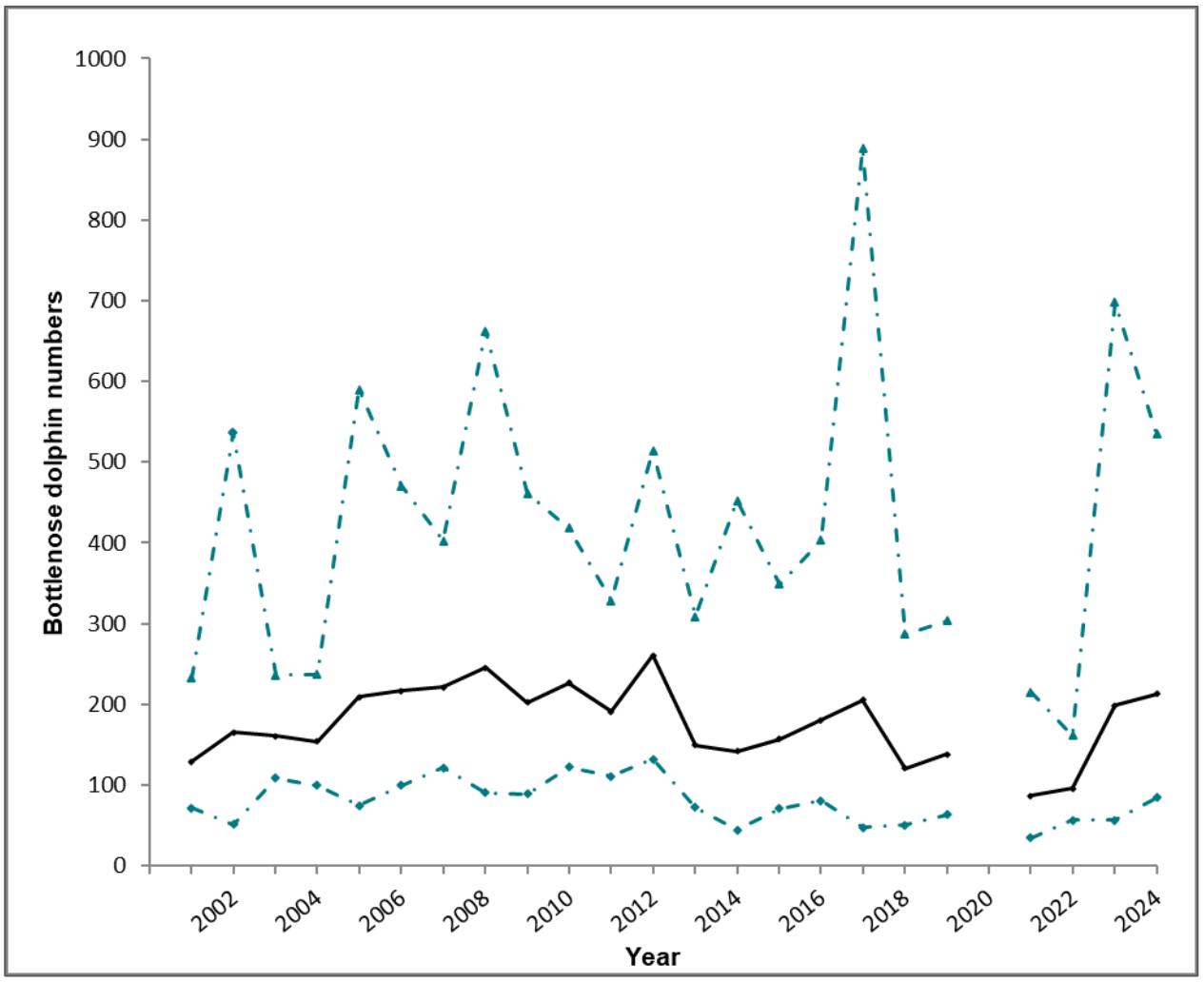
Population

Cardigan Bay SAC is a key area for semi-resident coastal bottlenose dolphins, the largest of two such populations in the UK (Evans and Waggitt, 2023). Dedicated monitoring with photo-identification of bottlenose dolphins commenced in 2001 in Cardigan Bay SAC and was expanded in 2005 to include the wider Cardigan Bay, including a large part of the Pen Llŷn a'r Sarnau SAC. Bottlenose dolphins identified in Cardigan Bay have been recorded ranging from north Pembrokeshire to Anglesey, Liverpool Bay and the Isle of Man, though none have been matched to individuals seen outside of the Irish Sea (Feingold and Evans, 2012; Lohrengel et al., 2018). Numbers in Cardigan Bay are highest in the summer with many moving out of Welsh waters to the Isle of Man and Liverpool Bay to the north in the winter (Lohrengel et al., 2018; Evans and Waggitt, 2023).

A combination of boat-based line transect surveys and photo identification have been carried out since 2001. These were used to produce bottlenose dolphins population abundance estimates through distance sampling along a line transect and capture-mark-recapture (CMR) analysis of photo-identified individuals (Lohrengel et al., 2018). The CMR data are fed into two types of models: a closed model that assumes an unchanged population between sampling, and a robust design model which takes into account the population being open to births, death and individuals entering and leaving the population (Lohrengel et al., 2018). NRW recommend that estimates derived from the closed CMR model are used preferentially, owing to their overall robustness.

The Cardigan Bay SAC abundance estimate for 2024, based on distance sampling, was 232 individuals (95% CI = 119 - 451; CV = 0.341). Using the CMR closed model, the population estimate for Cardigan Bay SAC was 213 bottlenose dolphins (95% CI = 85 - 535; CV = 0.497), although model fit for this particular year was poor (Figure 2). The CMR robust model resulted in a lower estimate of 117 bottlenose dolphins (no CV was possible for this estimate due to the distribution of recapture events (Lohrengel et al., in draft). While closed and open models gave rather different results, smoothed trend lines had similar trajectories across both models, showing a peak in the population around 2008 followed by a gradual decline until an upswing in recent years (Lohrengel et al., in draft). The smoothed trend line for Cardigan Bay SAC from distance sampling also shows similarities to the CMR smoothed trend lines but with a steeper increase in recent years. The wider Cardigan Bay abundance estimate for 2024, based on distance sampling, resulted in a larger than usual estimate of 734 (95% CI = 403 -1383; CV = 0.34), in which we have low confidence

Figure 2. Population estimates for bottlenose dolphins in Cardigan Bay SAC from 2001 to 2024 (solid line) obtained from CMR using a closed population model including 95% confidence intervals (dashed lines), excluding 2020 when no data were collected (Lohrengel et al., in draft).



The CMR model estimates for the wider Cardigan Bay area are typically larger than those of the SAC alone because they include individuals in the SAC as well as those in the whole of the Bay. However, the closed estimate for the wider Cardigan Bay in 2024 is lower than for Cardigan Bay SAC, likely due to the poor fit of the model for Cardigan Bay SAC for that year. The Closed model CMR estimate for the wider Cardigan Bay area was 211 animals (95% CI = 107 - 414; CV = 0.355) in 2024, while the robust model was again lower at 143 individuals (no CV available) (Lohrengel et al., in draft). While the closed and open models for the wider Cardigan Bay area gave different results, the smoothed trend lines followed a similar pattern to those from the SAC analyses. As before, the smoothed trend line for the wider Cardigan Bay from distance sampling also show similarities to the CMR trend except for a steeper increase in recent years.

Over the whole monitoring period (2001-2024), numbers using the SAC and the wider Cardigan Bay are variable but are deemed to be broadly stable overall. This meant the indicator of the number of bottlenose dolphins using the SAC in the long term passed with high confidence, especially when utilising the preferential CMR closed model data for the SAC. A decline since the peak of the population in the medium term (10 years) may be

part of a naturally fluctuating cycle or may indicate individuals moving out of the area, rather than a decline in the overall population of bottlenose dolphin. In the last three years, however, the population appears to have increased slightly. More monitoring data are needed to track this.

It is important to also consider bottlenose dolphin population in the short term as declines detected in this time frame would allow management to be implemented to prevent further decline. Short term has been defined as five years for the purposes of these condition assessments. The data from both Cardigan Bay SAC and the wider Cardigan bay show an increase in bottlenose dolphin numbers in the most recent years for both models. This meant the indicator of the number of bottlenose dolphins using the SAC in the short term passed. Due to the covid-19 pandemic and funding constraints, there were only four years of data (2021-2024) in the last five years (at the time of the assessment) using CMR in the SAC, and three years (2022-2024) in the wider Cardigan Bay. The confidence in the pass was high due to the robust monitoring data.

Reproduction

Cardigan Bay SAC has historically been considered an important nursery ground for bottlenose dolphins (Feingold and Evans, 2014; Lohrengel et al., 2018). In the wider Cardigan Bay area the majority of newborn bottlenose dolphin calves have been recorded in Cardigan Bay SAC in the last 10 years, and only within the SAC for several of those years (Lohrengel et al. in draft). This suggests Cardigan Bay SAC remains an important area for calving bottlenose dolphins.

Female bottlenose dolphins in Cardigan Bay can give birth in any month of the year but most births are in the summer, with 75% of births between July and September (Lohrengel et al 2018). The mean calving interval is 3.4 years (range 2-8 years) (Lohrengel et al in draft).

Crude birth rate

NRW recommend crude birth rates based on population sizes calculated using closed CMR models. Crude birth rate data show large inter annual variation over the monitoring period but seem to follow a pattern: High crude birth rate years (baby booms) are followed by a couple of years of low rates. However, the average crude birth rate in the SAC and wider Cardigan Bay has declined in each of three 8-year time periods since 2001 (see Table 4) and the birth rates appear to have continued to decline in the short term (Lohrengel et al in draft).

Due to this apparent decline in birth rate in the SAC, the Reproductive Success: Crude Birth Rate indicator failed to meet its target. Confidence in the failure was low due to the challenge of estimating this parameter and further investigation is required.

Table 4. Crude birth rates over time in Cardigan Bay SAC and the wider Cardigan Bay area (data from Lohrengel et al., in draft).

Monitoring period	Cardigan Bay SAC crude birth rate (%)	Wider Cardigan Bay crude birth rate (%)
2001-2008	5.1	6.51
2009-2016	4.64	5.11
2017-2024	3.06	2.96

Calf Survival

Another measure of reproductive success is calf survival. Calves are considered to be independent in their 4th year, so it is important to track their survival over the first three years of their life while they are reliant on their mother. This is a difficult metric to measure as mother calf pairs need to be identified and then continually tracked over three years. Calf survival is calculated for wider Cardigan Bay area only rather than the SAC.

Between 2009 and 2019 the 1st year calf survival (0-1 year) is 87%, 2nd year survival (1-2 years) is 80%, and 3rd year survival (2-3 years) is 92% (Lohrengel et al., in draft.). Between 2017 and 2023, only five mother and calf pairs were observed sufficiently to determine survival, all of which survived the first three years of life. Sample size since 2019 was low due to no data in 2020 (Covid) and calves born after 2021 were excluded from analysis as survival to their third year of life could not yet be determined. Calf survival data were deemed sufficient to allow the Reproductive Success: Calf Survival indicator to pass. Confidence was reduced to medium due to the lack of recent data and the inherently difficult nature of studying this indicator.

Residency

The bottlenose dolphin population in Cardigan Bay is one of only two major semi-resident populations of coastal bottlenose dolphins in the UK. It is this resident nature that was a primary reason for designating the SAC. Detecting residency in a mobile species is difficult and requires long term intensive monitoring with photo identification, ideally over the entire range of the population. Photo identification of bottlenose dolphin has taken place in the Cardigan Bay SAC since 2001, allowing residency to be determined. A bottlenose dolphin is deemed to be a resident if it is seen within the SAC for a minimum of seven years or on 12 separate occasions (Pesante et al. 2008; Feingold and Evans, 2012, 2014; Lohrengel et al., 2018).

Analysis of data between 2001 and 2024 showed that 'residents' made up 37% of animals sighted in the SAC . This was similar to the previous 38% estimate from data collected between 2001-2016, using the same methodology (Lohrengel et al., in draft). Within the wider Cardigan bay 67% of individuals were classed as resident. This was approximately a 10% increase on the 2016 analysis (Lohrengel et al., in draft). The proportion of residents appears to be stable over the monitoring period and as such we expect residency to be no less than 35%.

There is nothing in the most recent monitoring data to suggest that the proportion of residency has changed. The majority of individuals resident in wider Cardigan Bay were

also considered resident in Cardigan Bay SAC, highlighting that the SAC continues to be the most important area for bottlenose dolphins within the bay, although they are using the wider area extensively as well (Lohrengel et al., in draft). Therefore the SAC residency indicator has passed. Despite detection of residency being difficult, the length and quality of photo ID data mean the confidence in the pass is high.

Habitat accessibility and disturbance

The mobile nature of bottlenose dolphins means that they utilise a wide area for their functional needs (e.g. feeding, breeding). While presence of bottlenose dolphin at a particular location is likely to indicate some degree of reliance on the habitat associated with the location of that sighting, there is a lack of understanding on what constitutes suitable habitat for the species. Suitable habitat, however, is likely to be strongly correlated with prey availability. Repeated sightings of animals over time in particular areas are likely to indicate the habitat in that area is important for the species. An analysis of 30 years of sightings data and modelling with various factors representing habitat features, confirm that the wider Cardigan Bay area, especially Cardigan Bay SAC, the Llŷn Peninsula and west coast of Anglesey are persistently important areas for the regional coastal bottlenose dolphin population (Evans and Waggitt 2023). For this reason it is vital that bottlenose dolphins continue to have unimpeded access to the whole of the SAC and areas beyond it.

It is not only physical barriers that could reduce access to the SAC and areas beyond it that are considered to be functionally important/linked (i.e. necessary). Noise and visual stimuli could also disturb bottlenose dolphins and prevent them from accessing an area. Bottlenose dolphins that move away from an area due to disturbance (physical or otherwise) are said to be displaced. However, disturbance can occur at levels that does not cause bottlenose dolphins to leave an area but can still lead to negative outcomes. It is important to distinguish between activity and physical barriers that may displace bottlenose dolphins using the SAC from necessary habitats, with disturbance that may lead to adverse behavioural changes.

Bottlenose dolphins are known to forage and breed outside of the SAC boundaries. Therefore, we need to ensure functionally linked (i.e. necessary) habitats are available to them and their use of them is not constrained in such a way that the population that uses the SAC is adversely affected.

Habitat accessibility

Studies have suggested both short and long-term negative relationships with recreational activities in Cardigan Bay SAC. This may be as a result of recreational vessel users that do not comply with marine codes of conduct, causing increases in negative (i.e. avoidance and escaping) behaviour responses of bottlenose dolphins compared to those vessels adhering to the code (Koroza and Evans, 2022). Negative responses tended to be more pronounced in transient bottlenose dolphins compared to residents, suggesting some habituation is occurring (Koroza and Evans, 2022). While this is of concern, there is currently a lack of evidence that this activity is significantly constraining access for bottlenose dolphins to an extent that would impact the population associated with the SAC.

Projects and activities taking place outside of the SAC can pose a risk of preventing the bottlenose dolphins that use or are associated with Cardigan Bay SAC from accessing the

SAC (i.e. from offsite impacts). These risks mainly come from marine industrial developments and associated activities, especially in relation to collision and underwater noise. However, there is currently no evidence from developments or specialist knowledge that bottlenose dolphins are being significantly constrained in accessing the SAC from activity outside of it.

At the time of assessment, accessibility to habitat in the SAC used by bottlenose dolphins was not considered to be significantly constrained, allowing the indicator to pass. The confidence was reduced to low as there are uncertainties around the impacts that recreational activities are having on the ability of bottlenose dolphins to access the site, and the difficulties in defining when accessibility has been constrained.

Disturbance

Bottlenose dolphins, like all cetaceans, are sensitive to disturbance, particularly from underwater noise, as they rely heavily on sound to understand their surroundings and to communicate (Evans, 1996). Disturbance to bottlenose dolphin comes largely from underwater noise associated with boat traffic as well as noise from construction of industrial developments e.g. windfarms.

Disturbance can lead to behaviour changes such as reduced foraging and may have energetic and fitness costs that have negative consequences on populations (e.g. Chudzińska et al., 2024). One of the main sources of noise in Cardigan Bay is from vessel traffic. Boat noise has been shown to mask cues, affect the behaviour of bottlenose dolphins and their prey and cause stress (Pirottal et al., 2015 and references therein). An increase in tourist boats was shown to lead to a decrease in bottlenose dolphin abundance in Australia (Bejder et al. 2006); while this decrease in abundance was not thought to endanger that large genetically diverse population, such a decrease in smaller, resident populations could be damaging.

It is known that there is a moderate amount of disturbance occurring to bottlenose dolphin in Cardigan Bay SAC through recreational vessel use. As mentioned above, recreational users that were observed not to follow the marine codes of conduct, caused negative changes to bottlenose dolphin behaviour compared to those vessels adhering to the codes (Koroza and Evans, 2022). However, there is a lack of understanding on the impact that this level of disturbance is having on the bottlenose dolphin at a population level. For this reason this indicator has been assessed as unknown. Monitoring of disturbance is a gap in evidence (see Section 5).

Habitat quality

Contaminants

As top predators, marine mammals are vulnerable to contaminants, particularly those which biomagnify and / or bioaccumulate, such as persistent organic pollutants (POPs). Example of POPs include various pesticides, polychlorinated biphenyls (PCBs) that were historically used in manufacturing, and polybrominated diphenyl ethers (PBDEs) that were used as flame retardants in a variety of products. While many POPs have been banned in Europe since the 1970s and 80s, they take a very long time to degrade, resulting in the term ‘persistent’. Despite their use now being prohibited, they continue to enter the marine environment via use and disposal of products made before bans were introduced.

POPs pose a risk to bottlenose dolphins, which bioaccumulate and biomagnify these contaminants over their long life spans and store these lipophilic contaminants in their fat tissue (e.g. blubber) (Williams et al. 2023, and references therein). High levels of PCBs continue to be found in dolphins and cetaceans in European waters (Jepson et al., 2016; Williams et al., 2023; Zanuttini et al., 2019).

POPs are known to cause a variety of negative health implications in marine mammals such as anaemia, endocrine disruption (Tanabe et al., 1994; Vos et al., 2003; Schwacke et al., 2012), immune system suppression (Tanabe et al., 1994) and the subsequent increased vulnerability to infectious disease (Aguilar and Borrell, 1994a; Jepson et al., 2005), and reproductive impairment and developmental abnormalities (Tanabe et al., 1994; Schwacke et al., 2002, Vos et al., 2003). However, the impacts of these chemicals at the population level are not well understood.

In this condition assessment, the coastal Cardigan Bay Central waterbody has a fail for chemicals in the 2024 cycle 3 interim classification, where mercury and PBDE failed. The human health protection goal that is used for PBDE may be considered as over precautionary as the effect of contaminants on bottlenose dolphins are not fully understood. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife), which may be more relevant to bottlenose dolphins and is sampled from biota they may eat. Of the other two relevant WFD waterbodies within the SAC, one waterbody (Cardigan Bay South) was not classified as the chemicals have not been assessed within the last six years. The other waterbody (Teifi) has a pass for chemicals; however, the chemical classifications were rolled forward from the 2018 cycle 2 interim classification. It is also an estuarine waterbody, unlikely to be used by the bottlenose dolphins.

The Convention for the Protection of the Marine Environment of the North-East Atlantic or OSPAR, assess the state of the seas in the region. The latest quality report published in 2023 states that hazardous substances are still a cause for concern across the region, including the Irish Sea. Both mercury and lead are above ecological guidelines in the North-East Atlantic region, as is the most toxic congener (CB118) of PCB when measured in sediments and biota (fish, shellfish, birds and mammals) (Larsen and Hjermann, 2022; Webster and Fryer, 2022). Overall, PCBs in 2010-2020 were lower than the 1980s, but concentrations in some areas are still at levels that may cause adverse effect to marine life (Webster and Fryer, 2022). A recent UK study of 11 marine mammal species found 80% of stranded bottlenose dolphins were above toxicity thresholds for PCBs, with several washed up in Welsh waters (Williams et al., 2023).

Despite PCBs persisting in the Irish sea and being found in bottlenose dolphins at levels that would be expected to have a physiological impact on them, the population using the SAC remains stable. As there is no evidence that contaminants are having a detrimental impact to the population, the indicator passed. However, confidence is low for this indicator because the link to population level effects is unclear, and it is not certain whether those stranded bottlenose dolphins with measured levels of PCBs represent the coastal bottlenose dolphin population using the SAC. It is also not clear what the PCB levels are in live animals. Contaminants remain a threat to the coastal bottlenose dolphin population from both historical POPs and new emerging contaminants. There is an evidence need to better understand the impacts of POPs on the population and to measure levels in live bottlenose dolphins. This is especially important given the apparent reduction in crude birth rate in Cardigan Bay bottlenose dolphins and the known impacts of contaminants on

reproductive parameters seen in some marine mammal populations (Murphy et al., 2018; Tanabe et al., 1994; Schwacke et al., 2002, Vos et al., 2003).

Prey availability

Bottlenose dolphins are generalist and opportunistic feeders, eating a wide range of pelagic and benthic (demersal) fish, crustaceans and molluscs (i.e. squid and octopus), both within and outside of the SAC. From visual observations of the surface behaviour of bottlenose dolphins in Cardigan Bay, it is known that they catch pelagic fish (such as sea trout and bass), bottom dwelling fish (e.g. flatfish) and invertebrates (e.g. squid) (unpublished data from NRW, Sea Watch Foundation and the Wildlife Trusts). Hernandez-Milian et al., (2015) analysed stomach content of bottlenose dolphins stranded on the west coast of Ireland and indicated a wide variety of both benthic and pelagic prey was consumed. However, this study may better represent the offshore ecotype rather than coastal bottlenose dolphin associated with the Irish Sea and Cardigan Bay.

Prey availability is likely to be a key factor in determining the abundance and distribution of bottlenose dolphins in the Irish Sea, Cardigan Bay and the SAC. Recent analyses suggest that there have been changes in habitat use by Cardigan Bay bottlenose dolphins and an observed decline in birth rates (Lohrengel et al., in draft). Such declines have been linked to changes in prey availability in other marine mammal populations (Vermeulen et al., 2023; Wild et al., 2019; Williams et al., 2013) and could indicate the Cardigan Bay population may be adapting to a change in resource availability (Lohrengel et al in draft). A recent study in the Celtic Sea ecoregion found evidence of a decline in the nutritional health of common dolphin *Delphinus delphis* through measuring ventral blubber thickness, which is potentially linked to shifts or declines in prey availability (Albrecht et al., 2024).

However, there is currently insufficient robust evidence to suggest that bottlenose dolphin prey is limited in terms of abundance or diversity, although some key prey species are thought to be depleted in the Irish and Celtic Seas (ICES, 2024a, 2024b, 2024c, 2024d, 2024e, 2024f). The stability of the overall population and number of bottlenose dolphins using the SAC suggest prey availability within the SAC and wider areas are sufficient to sustain them. For this reason, the indicator passed. However, confidence was reduced to low due to several factors: the lack of understanding and targeted surveys on prey availability, the presence of several depleted fish stocks in the region and the potential links with the observed decline in crude birth rate. The assessment of the indicator was largely based on expert judgment.

Reason for target failure

The bottlenose dolphin feature in the Cardigan Bay SAC has been assessed as being in **favourable** condition. However, a secondary target failed to be met and needs to be kept under review.

Reproductive success: crude birth rate

This indicator target has a secondary weighting. Crude birth rate data show large inter annual variation over the monitoring period. However, birth rates appear to have declined over the longer term. Due to this apparent decline in birth rate in the SAC, the indicator failed its target. The reasons for the decline in crude birth rate are not clear. Low birth rates

have been linked to changes in prey availability in other populations. It is also known that high levels of contaminants in a population can suppress the birth rate. Further investigation is needed to understand why the birth rate is declining and if management can be put in place to help rates recover.

3.2. Pen Llŷn a’r Sarnau SAC condition assessment

Monitoring of the bottlenose dolphin *Tursiops truncatus* population in the wider Cardigan Bay that includes part of the Pen Llŷn a’r Sarnau SAC began in 2005 to expand the monitoring already taking place in the Cardigan Bay SAC. Monitoring uses a combination of photo ID and boat-based transect surveys. A summary of the condition assessment can be seen in Table 5. The assessment conclusion, a detailed summary of the assessment, any reasons for failure and threats to condition can be found in the sections below.

Table 5. Condition assessment of bottlenose dolphin in Pen Llyn a’r Sarnau SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting (see Section 1.1).

Indicator	Target (weighting)	Assessment rationale	Target assessment	Target confidence
Population size: Number of bottlenose dolphins using the SAC in the long term	A stable or increasing number of bottlenose dolphins using the SAC over the long term, allowing for natural change and variation. (P)	• Long term is 20 years, or more. • There is only one CMR estimate and two distance sampling estimates for the SAC from recent monitoring. Monitoring of the Cardigan Bay SAC and the wider Bay is also used as a proxy to assess the Pen Llyn a’r Sarnau SAC as a whole. • The bottlenose dolphins in the Cardigan Bay and Pen Llŷn a’r Sarnau SACs are part of the same population residing in the whole of Cardigan Bay. • The population using the SAC (i.e. based on Cardigan Bay SAC and wider Cardigan Bay estimates) has fluctuated over the monitored period (2001 - 2024). However, the population has been stable over the long term. • Confidence in the pass is medium due to lack of estimates in the Pen Llyn a’r Sarnau SAC and gaps in the wider Cardigan Bay monitoring data.	**Pass**	Medium

Indicator	Target (weighting)	Assessment rationale	Target assessment	Target confidence
Population size: Number of bottlenose dolphins using the SAC in the short term	A stable or increasing number of bottlenose dolphins using the SAC over the short term, allowing for natural change and variation. (P)	• Short term is five years, or less. • At the time of the assessment and due to gaps in monitoring, there were only two and three years of data (2022-2024) in the last five years for the SAC and wider Cardigan Bay area respectively. • The data were deemed insufficient to assess a trend. • Therefore the indicator was assessed as unknown.	**Unknown**	N/A
Reproductive success: crude birth rate.	A stable or increasing crude birth rate (proportion of newborns in the population) over the short term. Allowing for natural change and variation. (S)	• Crude birth rate is calculated for the wider Cardigan Bay rather than Pen Llŷn a'r Sarnau SAC • Crude birth rate data shows large inter annual variation over the monitoring period but seems to follow a pattern: years with a high crude birth rates (baby boom) are followed by a couple of years of low rates. • Data over the short term (five years) seem to be following this same pattern but appear to be lower compared to earlier data from the long term data series, and when compared to other coastal bottlenose populations. This warrants further investigation. • No newborns were recorded in the Pen Llŷn a'r Sarnau SAC in 2024. • Confidence in the fail is low due to the difficulty in collecting birth rate data accurately, the lack of specific coverage in Pen Llŷn a'r Sarnau SAC and the uncertainty in causes of low birth rate. Further analyses are required.	**Fail**	Low

Indicator	Target (weighting)	Assessment rationale	Target assessment	Target confidence
Reproductive success: calf survival	Calf survival in each of their first 3 years should be no less than 80%, allowing for natural change and variation. (S)	• Bottlenose dolphin calves needs to survive to their 4th year to be considered independent. • Data from the wider Cardigan Bay shows the proportion of calves surviving to three years old (i.e. their 4th year) fluctuates annually but with no significant trend. • When comparing recent values to those from previous reports, the proportions are similar. • From 2001 to 2019 (latest available analyses), average calf survival for the population in each assessment year was: 1st year (0-1 year) = 87%, 2nd year (1-2 years) = 80%, and 3rd year (2-3 years) = 92%. • Confidence is low due to the lack of recent data and the inherently difficult nature of studying this indicator.	**Pass**	Low
SAC Residency	No significant decline in the proportion of the dolphin population considered to be resident to the SAC, allowing for natural change and variation. (P)	• Data are focused at the level of the wider Cardigan Bay not the Pen Llŷn a'r Sarnau SAC. • Monitoring data indicate the proportion of residents in the wider Cardigan Bay is stable at around 68%. • CMR evidence shows that net movement outside of the Bay fluctuates over the years but should be no less than 65%. • Confidence in the pass is low due to the fact that residency in the SAC itself is not estimated (only in wider Cardigan Bay and Cardigan Bay SAC).	**Pass**	Low

Indicator	Target (weighting)	Assessment rationale	Target assessment	Target confidence
Accessibility to habitat used by bottlenose dolphins	No evidence of significant anthropogenic constraints on access of bottlenose dolphin using the SAC to necessary habitat within or associated with the site. (S)	• There is some evidence of both short and long-term negative relationships with recreational activities in the Pen Llŷn a'r Sarnau SAC, therefore any unregulated increase in tourism could lead to bottlenose dolphins avoiding the area in the future • Marine developments are routinely assessed for impacts to bottlenose dolphins, but such developments are largely absent at present from Pen Llŷn a'r Sarnau SAC and so are not likely to be limiting access to habitat. • There is currently no compelling evidence that bottlenose dolphins are avoiding any areas of necessary habitat due to anthropogenic drivers and are thus not being significantly constrained in accessing necessary habitats. • Confidence is low due to uncertainties around the population level impacts that activities have on bottlenose dolphins and the difficulty in defining when accessibility has been constrained.	**Pass**	Low

Indicator	Target (weighting)	Assessment rationale	Target assessment	Target confidence
Anthropogenic disturbance	No significant anthropogenic disturbance affecting the bottlenose dolphin population associated with the SAC. (S)	• There is some evidence of both short and long-term negative relationships with recreational activities in the Pen Llŷn a'r Sarnau SAC. Compliance with marine codes of conduct is generally good, although improvements are needed for compliance from some users. • It is known that some disturbance is occurring to bottlenose dolphin in the SAC through recreational boat use, but the extent and consequences are currently not well understood. • Marine developments are routinely assessed for disturbance impacts to bottlenose dolphins, but such developments are largely absent at present from Pen Llŷn a'r Sarnau SAC. • However, while anthropogenic disturbance can have consequences such as adverse behavioural reactions even if it does not reach the level of resulting in displacement from an area, there is a lack of understanding on the population level impact. • Therefore this indicator has been assessed as unknown.	**Unknown**	N/A

Indicator	Target (weighting)	Assessment rationale	Target assessment	Target confidence
Water, sediment and prey contaminants	Ensure water, sediment and prey contaminants are at levels not detrimental to the bottlenose dolphin population. (S)	• Two waterbodies relevant to the bottlenose dolphin have a failed for chemicals in the 2024 cycle 3 interim classification (Cardigan Bay North and Mawddach), due to PBDE and mercury. • OSPAR report that mercury and lead are above ecological guidelines in the North East Atlantic region, as is one congener of PCB. • OSPAR report that the PCB range in 2010-2020 was lower than the 1980s but still above marine mammal toxicity thresholds. • A study of marine mammals found 80% of stranded bottlenose dolphins were above toxicity thresholds for PCBs. Several were found in Welsh waters. • PCBs are at levels that would be expected to have a physiological impact on bottlenose dolphins. While birth rates are low in recent years, it is not possible to equivocally attribute this to PCBs. • As the population is stable and both mercury and PBDE are being managed, contaminants are deemed not to be having a detrimental impact on bottlenose dolphins at present. • Confidence is low as the population impact of the possible levels of contaminants in the bottlenose dolphins using the SAC is not clear.	**Pass**	Low

Indicator	Target (weighting)	Assessment rationale	Target assessment	Target confidence
Prey availability	Maintain the quality, abundance and diversity of prey species needed to support the bottlenose dolphin population. (S)	• Bottlenose dolphins feed on a wide variety of prey. • The population using the SAC is stable in the long term with an increase in recent years, suggesting prey is, at least in part, not limiting population growth. • There is insufficient evidence to suggest that bottlenose dolphins are prey limited or that there has been a reduction in the diversity or abundance of available species. However, changes in habitat use and decline in birth rates could indicate the population may be adapting to a change in resource availability. • Confidence in the pass is low due to the potential link between prey availability and declining birth rate, the presence of several depleted fish stocks in the region and as the assessment is based largely on expert judgement.	**Pass**	Low

Assessment conclusions

Bottlenose dolphin in Cardigan Bay SAC have been assessed to be in **favourable** condition (low confidence). Overall the stable population of bottlenose dolphins using the SAC in the long and short term as well as no significant evidence of reduction in habitat quality led to the favourable assessment. However, one indicator with a secondary target failed due to an apparent decline in birth rate (Table 6). Two indicators with secondary targets were also assessed as unknown. This contributed to the low confidence in the overall favourable assessment. Further investigation is required to see why the crude birth rate is in decline. See Section 4 for more information on threats to condition.

Table 6. Condition assessment summary for bottlenose dolphin in Pen Llŷn a'r Sarnau SAC. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SAC	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Pen Llŷn a'r Sarnau	**Favourable (low confidence)**	Reproductive success: crude birth rate (S)	• Declining crude birth rates in the long term.	• Recreational disturbance • Contaminants • Prey availability

Detailed assessment information

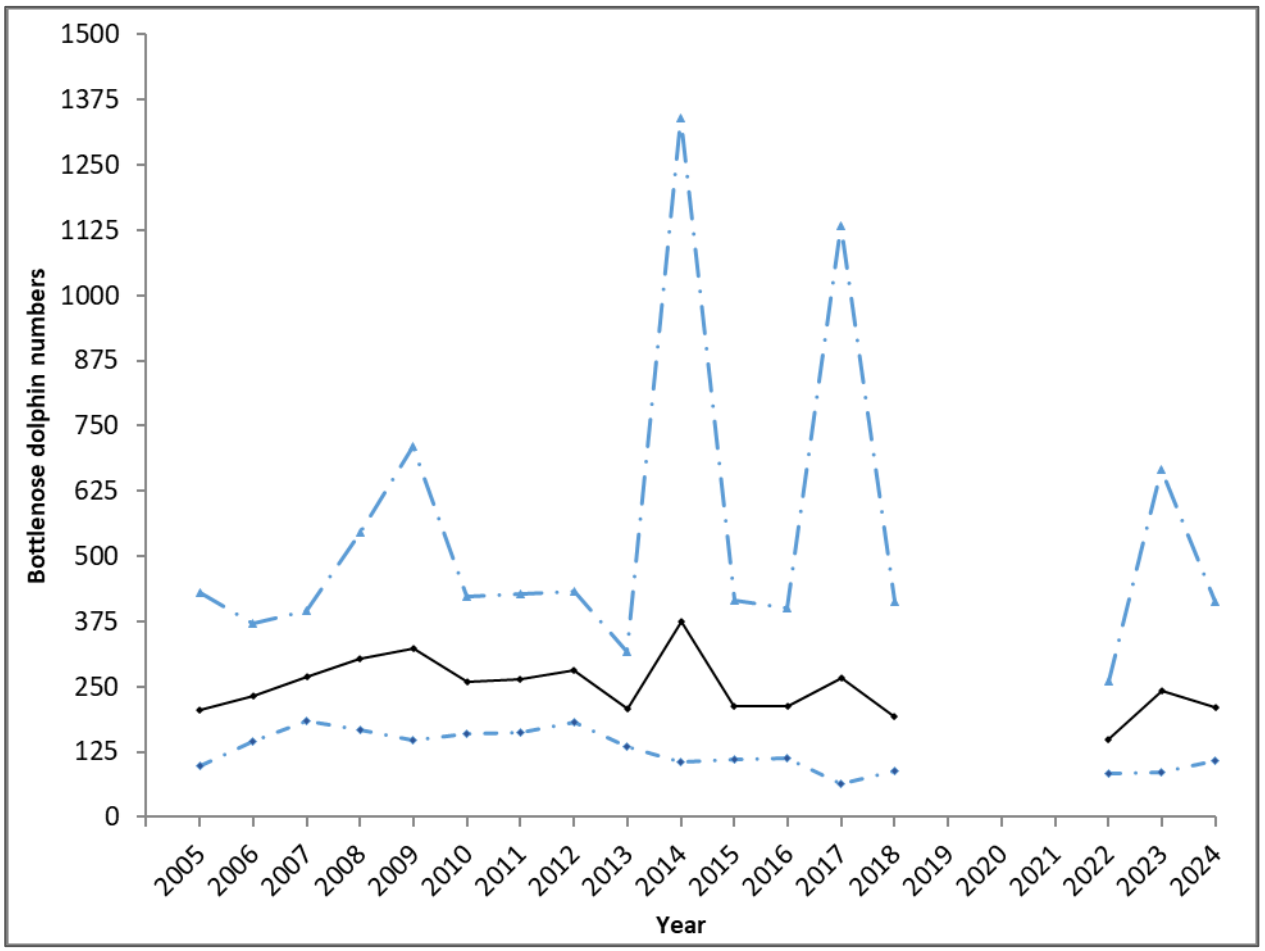
Population

The Pen Llŷn a'r Sarnau SAC is assessed primarily using data collected in wider Cardigan Bay and Cardigan Bay SAC. The SAC is within the northern half of Cardigan Bay. Being a mobile species, the bottlenose dolphins found in the SAC are the same as those in Cardigan Bay SAC and the surrounding seas. For more information on the bottlenose dolphin population and monitoring techniques see the Cardigan Bay SAC assessment.

For the Pen Llyn a'r Sarnau SAC, the 2024 abundance estimate based on distance sampling was 218 (95% CI=34-1043; CV = 0.83). The closed model CMR estimate for Pen Llyn a'r Sarnau SAC in 2023 was 106 bottlenose dolphins (95% CI = 73-192; CV = 0.691); no CMR estimate was available in 2024.

The wider Cardigan Bay abundance estimates for 2024, based on distance sampling, was 734 (95% CI = 403 -1383; CV = 0.34); this is a larger estimate than usual with which we have low confidence. The CMR model estimates for the wider Cardigan Bay area are typically larger than those of the SACs alone because they include individuals in the SACs as well as those in the whole of the bay (Figure 3). However, the closed estimate for the wider Cardigan Bay in 2024 was lower than for Cardigan Bay SAC, likely due to the poor fit of the model for Cardigan Bay SAC in that year. The closed model CMR estimate for the wider Cardigan Bay area in 2024 was 211 animals (95%CI = 107 - 414; CV = 0.355), while the robust model was again lower at 143 individuals (no CV available) (Lohrengel et al., in draft). While the closed and open models for the wider Cardigan Bay area gave different results, the smoothed trend lines followed similar patterns to those from Cardigan Bay SAC analyses. As before, the smoothed trend line for wider Cardigan Bay from distance sampling also showed similarities to the CMR trends, except for a steeper increase in recent years.

Figure 3. Population estimates for bottlenose dolphins in the wider Cardigan Bay from 2001 to 2024 (solid line) obtained from CMR using a closed population model including 95% confidence intervals (dashed lines), excluding 2019-2021 when no data were collected (Lohrengel et al., in draft).



Over the whole monitoring period (2001-2024), numbers of bottlenose dolphins using the wider Cardigan Bay fluctuate but appear to be stable overall. This meant the indicator of the number of bottlenose dolphins using the Pen Llŷn a'r Sarnau SAC in the long term passed. As the data is mainly based on the wider bay and not the SAC itself, the indicator passed with medium confidence. A decline since the peak of the population around 2008 may have been part of a naturally fluctuating cycle or may have indicated individuals moving out of the area, rather than a decline in the overall population of bottlenose dolphin. In the last three years, however, the population appears to have increased slightly. More monitoring data are needed to track this.

In order to detect problems in the bottlenose dolphin population in a timeframe that would allow management measures to be put in place before declines became established, it is important to look at the population abundances in the short term. Short term has been defined as five years for the purposes of these condition assessments. Due to the covid-19 pandemic and funding constraints, there were only three years of data (2022-2024) in the last five years (at the time of the assessment) for the wider Cardigan Bay. This was deemed to be insufficient to assess trends over the short term and thus the indicator was classified as unknown.

Reproduction

For information on reproduction see the Cardigan Bay SAC assessment.

Crude birth rate

Crude birth rates appear to have declined over the longer term in the wider Cardigan Bay area (Table 7). This is used as a proxy for the Pen Llŷn a'r Sarnau SAC. No newborns were recorded in the Pen Llŷn a'r Sarnau SAC in 2024.

Table 7. Crude birth rates over time in Cardigan Bay SAC and the wider Cardigan Bay area Data from Lohrengel et al. (in draft).

Monitoring period	Wider Cardigan Bay crude birth rate (%)
2001-2008	6.51
2009-2016	5.11
2017-2024	2.96

Due to this apparent decline in birth rate in the wider Cardigan Bay, and thus the SAC, the Reproductive Success: Crude Birth Rate indicator failed to meet its target. Confidence in the failure was low due to the challenge of estimating this parameter, the lack of specific coverage in Pen Llŷn a'r Sarnau SAC and the uncertainty in causes of low birth rate. Further investigation is required.

Calf survival

Another measure of reproductive success is calf survival. This is calculated for wider Cardigan Bay rather than the SAC. Between 2009 and 2019, the 1st year calf survival (0-1 year) is 87%, 2nd year survival (1-2 years) is 80%, and 3rd year survival (2-3 years) is 92% (Lohrengel et al., in prep.). Between 2017 and 2023, only five mother and calf pairs were observed sufficiently to determine survival, all of which survived the first three years of life. Sample size since 2019 was low due to no data in 2020 (Covid) and calves born after 2021 were excluded from analysis as survival to their third year of life could not yet be determined. Calf survival data were deemed sufficient to allow the Reproductive Success: Calf Survival indicator to pass. Confidence was reduced to low due to the lack of recent data and the inherently difficult nature of studying this indicator.

Residency

For information on residency see the Cardigan Bay SAC assessment.

Analysis of data between 2001 and 2024 showed that 'residents' made up 67% of animals in the wider Cardigan Bay area. There is no estimate of residency for Pen Llŷn a'r Sarnau SAC alone. The proportion of residents appears to be stable over the monitoring period and as such we expect residency to be no less than 65%, in the wider region; there is nothing to suggest that the proportion of residency has changed over the monitoring period and the indicator passed. Despite the length and quality of photo ID data in the wider Cardigan Bay area, the confidence in the pass is low due to these data being a proxy for the Pen Llŷn a'r Sarnau SAC.

Habitat accessibility and disturbance

For information on habitat accessibility and disturbance see the Cardigan Bay SAC assessment.

Studies have suggested both short and long-term negative relationships with recreational activities in Cardigan Bay. This may be as a result of recreational vessel users that do not comply with marine codes of conduct, causing increases in negative behaviour responses of bottlenose dolphins compared to those vessels adhering to the code (Koroza and Evans, 2022). Negative responses tended to be more pronounced in transient bottlenose dolphins compared to residents, suggesting some habituation is occurring (Koroza and Evans, 2022). While this is of concern, there is currently a lack of evidence that this activity is significantly constraining access for bottlenose dolphins to an extent that would impact the population associated with the SAC.

Projects and activities taking place outside of the Pen Llŷn a'r Sarnau SAC can pose a risk of preventing the bottlenose dolphins that use or are associated with SAC from accessing the SAC (i.e. from offsite impacts). These risks mainly come from marine industrial developments and associated activities, especially in relation to collision and underwater noise. However, there is currently no evidence from developments or specialist knowledge that bottlenose dolphins are being significantly constrained in accessing the SAC from activity outside of it.

At the time of assessment, accessibility to habitat in the SAC used by bottlenose dolphins was not considered to be significantly constrained, allowing the indicator to pass. The confidence was reduced to low as there are uncertainties around the impacts that recreational activities are having on the ability of bottlenose dolphins to access the site, and the difficulties in defining when accessibility has been constrained.

Disturbance

One of the main sources of noise in Cardigan Bay is from vessel traffic. Boat noise has been shown to mask cues, affect the behaviour of bottlenose dolphins and their prey and cause stress (Pirottal et al., 2015 and references therein). An increase in tourist boats was shown to lead to a decrease in bottlenose dolphin abundance in Australia (Bejder et al. 2006); while this decrease in abundance was not thought to endanger that large genetically diverse population, such a decrease in smaller, resident populations could be damaging.

It is known that there is a moderate amount of disturbance occurring to bottlenose dolphin in Pen Llŷn a'r Sarnau SAC through recreational vessel use. As mentioned above, recreational users that were observed not to follow the marine codes of conduct, caused negative changes to bottlenose dolphin behaviour compared to those vessels adhering to the codes (Koroza and Evans, 2022). However, there is a lack of understanding on the impact that this level of disturbance is having at a population level. For this reason this indicator has been assessed as unknown and monitoring of disturbance is a gap in evidence (see Section 5).

Habitat quality

Contaminants

For information on bottlenose dolphins and contaminants see the Cardigan Bay SAC assessment.

In this condition assessment, two of the WFD waterbodies in the Pen Llŷn a'r Sarnau SAC have a fail for chemicals in the 2024 cycle 3 interim classification. These are Cardigan Bay North, which fails for PBDE and mercury, and Mawddach, which fails for PBDE. The human health protection goal that is used for PBDE may be considered as over precautionary as the effect of contaminants on bottlenose dolphins are not fully understood. The EQS for mercury is based on the secondary poisoning protection goal (for wildlife), which may be more relevant to bottlenose dolphins and is sampled from biota they may eat.

The Dyfi / Leri waterbody passed for chemicals in the 2024 cycle 3 interim classification; however, the chemical classifications were rolled forward from the 2021 cycle 3 classification. In addition, there have been failures for PBDE in this waterbody in previous cycles (Cycle 2), but it has not been assessed in the cycle 3 classifications. All of the other waterbodies within the SAC were not classified, as the chemicals have not been assessed within the last six years. However, most of these, along with the Dyfi / Leri are transitional (estuarine) waterbodies, unlikely to be used by bottlenose dolphins.

The Convention for the Protection of the Marine Environment of the North-East Atlantic or OSPAR, assess the state of the seas in the region. The latest quality report published in 2023 states that hazardous substances are still a cause for concern across the region, including the Irish Sea. Both mercury and lead are above ecological guidelines in the North-East Atlantic region, as is the most toxic congener (CB118) of PCB when measured in sediments and biota (fish, shellfish, birds and mammals) (Larsen and Hjermann, 2022; Webster and Fryer, 2022). Overall, PCBs in 2010-2020 were lower than the 1980s, but concentrations in some areas are still at levels that may cause adverse effect to marine life (Webster and Fryer, 2022). A recent UK study of 11 marine mammal species found 80% of stranded bottlenose dolphins were above toxicity thresholds for PCBs, with several washed up in Welsh waters (Williams et al., 2023).

Despite PCBs persisting in the Irish sea and being found in bottlenose dolphins at levels that would be expected to have a physiological impact on them, the population using the SAC remains stable. As there is no evidence that contaminants are having a detrimental impact to the population, the indicator passed. However, confidence is low for this indicator because the link to population level effects is unclear, and it is not certain whether those stranded bottlenose dolphins with measured levels of PCBs represent the coastal bottlenose dolphin population using the SAC. It is also not clear what the PCB levels are in live animals. Contaminants remain a threat to the coastal bottlenose dolphin population from both historical POPs and new emerging contaminants. There is an evidence need to better understand the impacts of POPs on the population and to measure levels in live bottlenose dolphins. This is especially important given the apparent reduction in crude birth rate in Cardigan Bay bottlenose dolphins and the known impacts of contaminants on reproductive parameters seen in some marine mammal populations (Murphy et al., 2018; Tanabe et al., 1994; Schwacke et al., 2002, Vos et al., 2003).

Prey availability

The prey availability assessment was the same for both SACs as the same sources of data were used for both. The conclusions made in the Cardigan Bay SAC assessment are the same for the Pen Llŷn a'r Sarnau SAC. See the Cardigan Bay assessment for more detailed information.

There is currently insufficient robust evidence to suggest that bottlenose dolphin prey is limited in terms of abundance or diversity in the Pen Llŷn a'r Sarnau SAC, although some key prey species are thought to be depleted in the Irish and Celtic Seas (ICES 2024). The stability of the overall population and number of bottlenose dolphins using the SAC suggests prey availability is sufficient to sustain them. For this reason, the indicator passed. However, confidence was reduced to low due to several factors: the lack of understanding and targeted surveys on prey availability, the presence of several depleted fish stocks in the region and the potential links with the observed decline in crude birth rate. The assessment of the indicator was largely based on expert judgment.

Reason for target failure

The bottlenose dolphin feature in the Pen Llŷn a'r Sarnau SAC has been assessed as being in **favourable** condition. However, However, a secondary target failed to be met and needs to be kept under review.

Reproductive success: crude birth rate

This indicator target has a secondary weighting. Crude birth rate data show large inter annual variation over the monitoring period. However, birth rates appear to have declined over the longer term. Due to this apparent decline in birth rate in the wider Cardigan Bay, the indicator failed its target. The reasons for the decline in crude birth rate are not clear. Low birth rates have been linked to changes in prey availability in other populations. It is also known that high levels of contaminants in a population can suppress the birth rate. Further investigation is needed to understand why the birth rate is declining and if management can be put in place to help rates recover.

4. Threats to condition

Part of this condition assessment process is to identify threats to the condition of the bottlenose dolphin feature. A threat is defined as an activity that has the potential to have a negative impact on feature condition over the next reporting cycle, if activity levels increase or are unmanaged to the point that the activity is regarded as damaging. It is important to identify these threats to, where relevant, be able to put pre-emptive management in place to prevent declines in condition.

As the threats to bottlenose dolphin are the same across both SACs they have been listed here once to avoid repetition.

Disturbance

Recreational disturbance when users do not adhere to marine codes of conduct has been shown to produce negative behavioural responses in the bottlenose dolphins of Cardigan Bay (Koroza and Evans, 2022). If this recreational disturbance was to increase it could have a detrimental impact on the population, and may result in bottlenose dolphins not using or being displaced from the SAC. There is also a lack of understanding around the long term impacts the current level of recreational disturbance is having on the population.

Underwater noise from construction, operation or decommissioning of marine developments may disturb cetaceans. However, environmental impacts from these developments are routinely assessed and managed; for example, mitigation measures are sometimes used to reduce or remove underwater noise. Noisy developments are, however, largely absent from Cardigan Bay at present.

Contaminants

At the time of the assessment, bottlenose dolphins are not thought to be detrimentally impacted by contaminants at the population level. However, the levels of some contaminants exceeding ecological guidelines within the SACs are cause for concern and could potentially be linked to the declining crude birth rate observed. While some contaminants like, PCBs mercury and PBDE are under management and will not increase, there is the potential for unregulated contaminants (such as Per- and polyfluoroalkyl substances (PFAS) and pharmaceuticals) to potentially increase in the future. Bioaccumulation potential of POPs means the levels in top predators such as bottlenose dolphins, may still be of some concern. Many contaminants have been shown to have a detrimental impact on bottlenose dolphins (Tanabe et al., 1994; Schwacke et al., 2002 Vos et al., 2003).

Prey availability

Prey availability is likely to be a key factor in determining the abundance and distribution of bottlenose dolphins in the Irish Sea, Cardigan Bay and the SACs. There is currently insufficient robust evidence to suggest that bottlenose dolphin prey is limited in terms of abundance or diversity, although some key prey species are thought to be depleted in the Irish and Celtic Seas (ICES 2024). The stability of the overall population and number of bottlenose dolphins using the bay and SACs suggests prey is sufficient to sustain them. However, with incomplete understanding of prey availability, limited targeted surveys on prey, and presence of several depleted fish stocks in the region, more research is needed.

5. Evidence gaps for bottlenose dolphin

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 8 for details.

Table 8. Evidence gaps for bottlenose dolphins 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 size: Number of bottlenose dolphins using the SAC in the short term (P)	Unknown	• Pen Llŷn a'r Sarnau SAC. Insufficient data to assess this indicator. More targeted surveys within the SAC are needed.
SAC residency (P) (Pen Llŷn a'r Sarnau SAC)	Low confidence	• There is currently no residency estimate for Pen Llŷn a'r Sarnau SAC. More targeted surveys within the SAC are needed.
Accessibility to habitat used by bottlenose dolphins (S)	Low confidence	• Lack of understanding on what constitutes necessary habitats for bottlenose dolphins that use the SAC and the impacts of recreational boats use on habitat use.
Anthropogenic disturbance (S)	Unknown	• Lack of understanding on the population level impacts of disturbance from recreational vessels on bottlenose dolphins that use both SACs.
Water, sediment and prey contaminants (S)	Low confidence	• Lack of understanding on the population level impacts of contaminants and the levels found within live bottlenose dolphins that use both SACs.
Prey availability (S)	Low confidence	• Lack of data on the diversity and abundance of dolphin prey in SACs. More targeted surveys on key prey species are needed.

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