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Condition assessment for the designated feature of Ardal Gwarchodaeth Arbennig Aber Dyfi / Dyfi Estuary Special Protection Area.

Report No: 911

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Greenland white fronted goose family on the Dyfi estuary 2024 © Gareth Thomas

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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 Ardal Cadwraeth Arbennig (AGA) Aber Dyfi. Mae adran un yn rhoi trosolwg o'r broses asesu ac mae adran dau yn rhoi disgrifiad o'r AGA a'i nodweddion.

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Nodweddion Dynodedig	Asesiad cyflwr	Hyder yn yr asesiad
Gŵydd dalcen wen *Anser albifrons flavirostris*	Anffafriol	Uchel

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 assessment of Greenland white-fronted goose *Anser albifrons flavirostris* within the Dyfi Estuary / Aber Dyfi Special Protection Area (SPA). Section 1 gives an overview of the assessment process and Section 2 provides a description of the feature.

The assessments are based on the best evidence available at the time of assessment (early 2025). 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 the designated feature of the Dyfi Estuary / Aber Dyfi SPA.

Designated Features	Condition assessment	Confidence in assessment
Greenland white-fronted goose *Anser albifrons flavirostris*	Unfavourable	High

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 new full assessment process, which has been delivered through the Welsh Government funded improving marine conservation advice (IMCA) project, has used 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.

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: Details 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. Site and feature description

2.1 Site description

The Dyfi estuary is located on the west coast of Wales on the boundary between the counties of Ceredigion, Gwynedd and Powys. The Dyfi Estuary / Aber Dyfi special protection area (SPA) (hereafter called Dyfi Estuary SPA) comprises the estuary with the main freshwater input being the River Dyfi along with smaller rivers such as the Leri and Cletwr. The estuary is fringed with saltmarsh especially on its southern margin and at low tide there are intertidal sand banks and mudflats. The SPA also includes drained and reclaimed areas of saltmarsh and peatland protected from tidal inundation by flood banks and kept drained by a network of ditches. The majority of these reclaimed areas are managed as pasture grassland for sheep and cattle and as a nature reserve. Adjacent to the SPA and within the wider wetland complex are an estuarine raised bog and sand dunes.

The SPA is overlapped by the Dyfi site of special scientific interest (SSSI), Pen Llŷn a'r Sarnau special area of conservation (SAC), Cors Fochno and Dyfi Ramsar, along with the Dyfi Biosphere. The Dyfi national nature reserve (NNR) which is managed by NRW covers the majority of the estuary and the Royal Society for the Protection of Birds (RSPB) manage a reserve which covers a significant part of the estuary and adjacent habitat. The Cors Fochno SAC lies to the south of the estuary and comprises one of the largest areas of primary raised bog in the UK.

The site is important as a traditional wintering area for Greenland white-fronted goose *Anser albifrons flavirostris* – the most southerly regularly used area for this sub-species in the UK. The site was designated in 2001 under Article 4.1 of the Birds Directive (79/409/EEC) for regularly supporting at least 1% of the UK population of over wintering Greenland white-fronted goose. The site is the sole SPA designated for Greenland white-fronted goose in England and Wales with a further 11 SPAs designated for the sub-species in Scotland and 29 in Ireland (NPWS 2024, Stroud et al., 2001).

More information on the site can be found in NRW's conservation advice for the site on our website.

2.2 Feature description

Greenland white-fronted goose is a sub-species of greater white-fronted goose *Anser albifrons*. The world population of Greenland white-fronted geese is small and their global range limited. Breeding is restricted to the tundra and wetlands of west Greenland and the winter range of the global population falls within western Britain and Ireland. The sub-species winters in some 70 regularly occupied sites of which the distribution is closely linked to the distribution of oceanic mire which is the traditional feeding habitat of the sub-species although recently, parts of the wintering population have shifted to foraging on managed agricultural grasslands (Fox, 2003).

It is a long range migrant with the Dyfi estuary population migrating a total of ca. 6,000 km per annum (Fox et al., 1999; Mitchell et al., 2018). The spring and autumn migration between the breeding and wintering grounds is broken by a staging period of 3-5 weeks in Iceland with the Dyfi estuary population staging in the southern lowlands of Arnessýsla, Rangárvallassýsla and Vestur Skaftafellssýsla (Fox et al., 1999, Mitchell et al., 2018).

An International Single Species Action Plan (ISSAP) has been prepared for Greenland white-fronted goose as part of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) (Stroud et al., 2012). The sub-species is categorised as Endangered using the International Union for Conservation of Nature (IUCN) Red List criteria and white-fronted goose as a species is red-listed in Wales (Johnstone et al. 2022) and the UK (Stanbury et al. 2021). The global population reached a peak of 35,600 in spring 1999 but has declined by 57.8% to a total of 14,997 birds in spring 2024 (Stroud et al. 2012; Fox et al., 2024). The only known regular wintering populations in Wales are on the Dyfi estuary and at Cors Ddyga on Ynys Môn (Anglesey). Other traditional sites in Wales such as Cors Caron are no longer used (Fox and Stroud 1985, Pritchard et al., 2021). The Dyfi Estuary SPA population is important for maintaining the wintering range of the population, being the most southerly population in the UK.

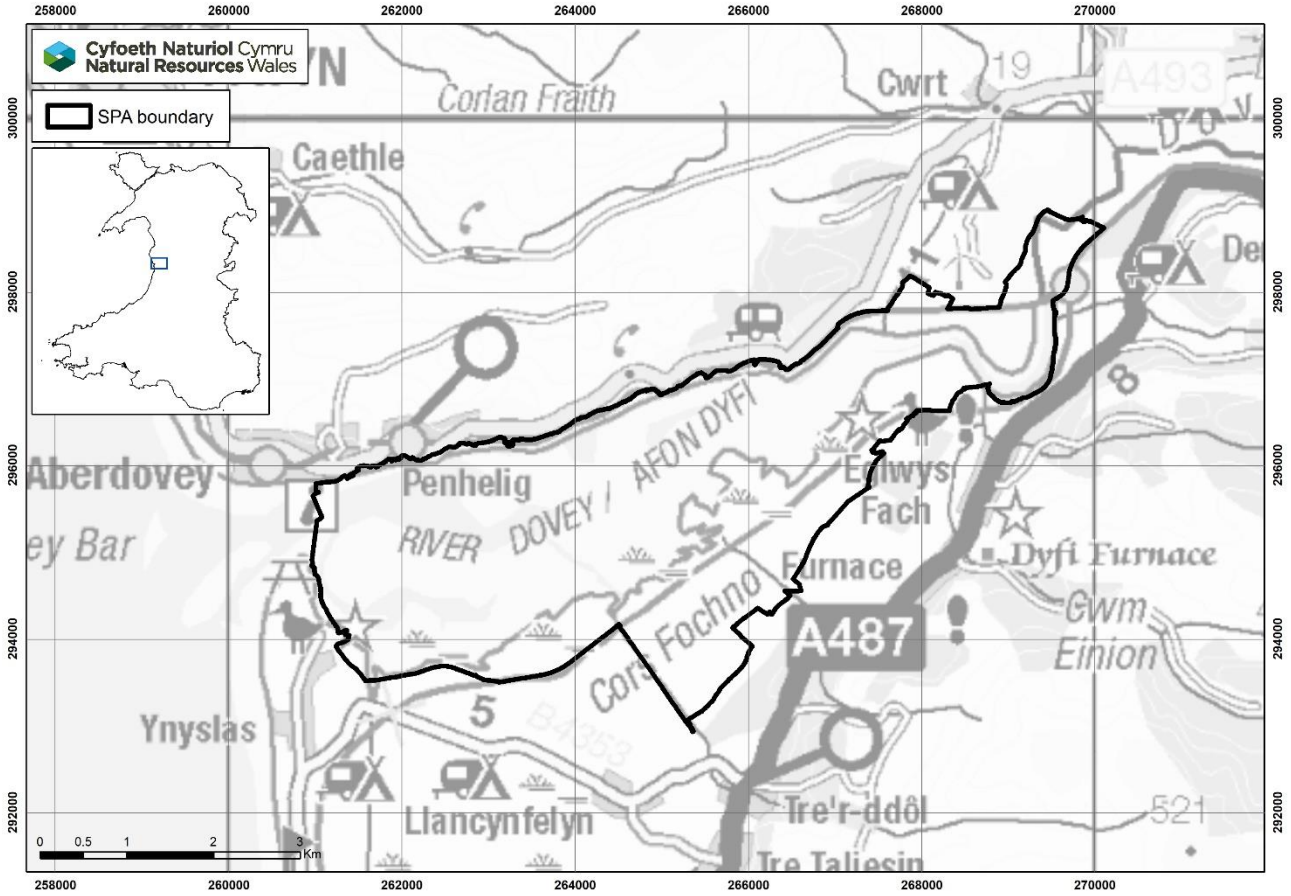
The Greenland white-fronted goose currently arrives on the Dyfi Estuary SPA between late October and early November and leaves in early April. These geese are long-lived and exhibit social behaviour with extended parent-offspring relationships (Warren et al., 1993, Fox, 2003) with the wintering population consisting of family groups. Greenland white-fronted geese tend to be extremely faithful, both to their wintering sites in the UK and Ireland and the areas they use within the site (Wilson et al., 1991, Warren et al.,1992).

3. Feature condition assessments

Information used in the condition assessment is based on data collected at the site by NRW and RSPB and by the expert knowledge and judgement of NRW staff. It is also informed by data from the Greenland White-fronted Goose Study (GWFS) who have co-ordinated an annual census of wintering sites for the species in Britain and Ireland since 1982/83. The GWFS data have informed the assessment as the census provides a 40-year data-set to inform population level conservation management.

Figure 1 is a map of the location of Dyfi Estuary SPA.

Figure 1. Map of the Dyfi Estuary SPA.



3.1. Condition assessment for Greenland white-fronted goose *Anser albifrons flavirostris*

Greenland white-fronted goose *Anser albifrons flavirostris* in the Dyfi Estuary SPA has been assessed in Table 2. The table has a summary of the assessment outcome against each performance indicator. This outcome and reasons of failure are discussed in more detail in the sections below.

Table 2. Condition assessment of Greenland white-fronted goose in the Dyfi Estuary SPA. 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
Size of wintering population	The wintering population of Greenland white-fronted goose is ≥1% of the national (UK) population. (P)	• In the six winters from 2019/20 to 2024/25 there were between 10 and 24 Greenland white-fronted goose present on the SPA, representing approximately 0.1% - 0.2% of the national (UK) wintering population. • The count of the wintering population in 2001 when the SPA was classified was 136. Since 2001 there has been an approximate 85% decline in the Dyfi estuary population. This rate of decline is higher than that of the global population over the same time period. • Confidence is high as the latest site numbers are much lower than the set target.	**Fail**	High

Indicator	Target	Assessment rationale	Target assessment	Target Confidence
Winter survival / mortality rate	Winter mortality levels are <1% annually. (P)	• Winter mortality rate is estimated to have been less than 1% in five of the six winters from 2019/20 to 2024/25. • Mortality rate in the 2022/23 winter was estimated to be greater than 1% as a single bird was observed absent from the wintering population from the third week of January 2023 to the flock departing the SPA in spring. • The low number of birds in the SPA wintering population means loss of a single bird results in the winter mortality rate being above 1%. • This target has been assessed as unknown as it is not possible to attribute loss of birds from the SPA population in any winter to mortality. Birds have been known to move to other wintering sites in Ireland and Scotland.	**Unknown**	N/A
Proportion of juvenile geese to adults	The flock comprises 5% juvenile/sub-adult birds annually. (P)	• No juvenile (first year) geese were recorded in two of the six winters from 2019/20 to 2024/25, causing the indicator to fail. The proportion of juvenile birds in the SPA wintering population varied between 0 and 29% during the six years, with the target failing in the 2022/23 and 2023/24 winters. • Productivity of Greenland white-fronted goose is declining in the global population. The proportion of juvenile birds in Britain and Ireland was 4.9% and 2.5% in the 2022/23 winter and 3.0% and 2.9% in the 2023/24 winter following poor reproductive success in the 2022 and 2023 breeding seasons. Productivity in the global population has therefore been below 5% for the last two years for which there are data. • Confidence is high because surveys found that there were no juvenile geese in the population in two of the last six winters.	**Fail**	High

Indicator	Target	Assessment rationale	Target assessment	Target Confidence
Wintering population disturbance (by human activity)	Aggregations of roosting or feeding Greenland white-fronted goose are not subject to significant anthropogenic disturbance. (P)	• Monitoring of the Dyfi Estuary SPA population in the last six years has shown disturbance of Greenland white-fronted goose resulting from a number of sources including land management, railway management, aircraft and recreation. • Permissions for some projects have been modified to introduce disturbance free buffer zones around feeding and roosting areas. Disturbance may be influencing distribution of the feature. • Confidence in the fail is high as the assessment of this indicator is based on direct monitoring of the population.	**Fail**	High
Supporting feeding habitat (sward quality and quantity, including height)	Maintain the extent, distribution, function and quality of Greenland white-fronted goose supporting feeding habitat. (P)	• Investigations have been undertaken during the last eight years to determine feeding habitat selection by Greenland white-fronted goose in the SPA. • Conclusions from the INTERREG funded ECHOES project were not available at the time of this condition assessment which led to an unknown assessment of this target.	**Unknown**	N/A

Assessment conclusions

Greenland white-fronted goose in the Dyfi Estuary SPA have been assessed as being in unfavourable (high confidence). Three primary indicators failed to meet their targets (Table 3). The main threats to the sub-species at the SPA level are considered to be climate change, disease and the extent of the SPA. Further information on the assessment outcome and threats to condition can be seen in the detailed assessment information below.

Table 3. Summary of the condition assessment for Greenland white-fronted goose in the Dyfi Estuary SPA. Each indicator target has a primary (P), secondary (S) or tertiary (T) weighting.

SPA Feature	Overall Condition Assessment	Indicator failures	Reason for indicator failure	Threats to condition
Greenland white-fronted goose *Anser albifrons flavirostris*	**Unfavourable (high confidence)**	Size of wintering population (P) Proportion of juvenile geese to adults (P) Wintering population disturbance (by human activity) (P)	• Poor productivity in the breeding areas leading to reduced over wintering numbers and fewer juveniles. • Anthropogenic disturbance directly affecting the feature and its distribution in the SPA.	• Climate change • Disease • Extent of SPA

Detailed assessment information

Size of over-wintering population

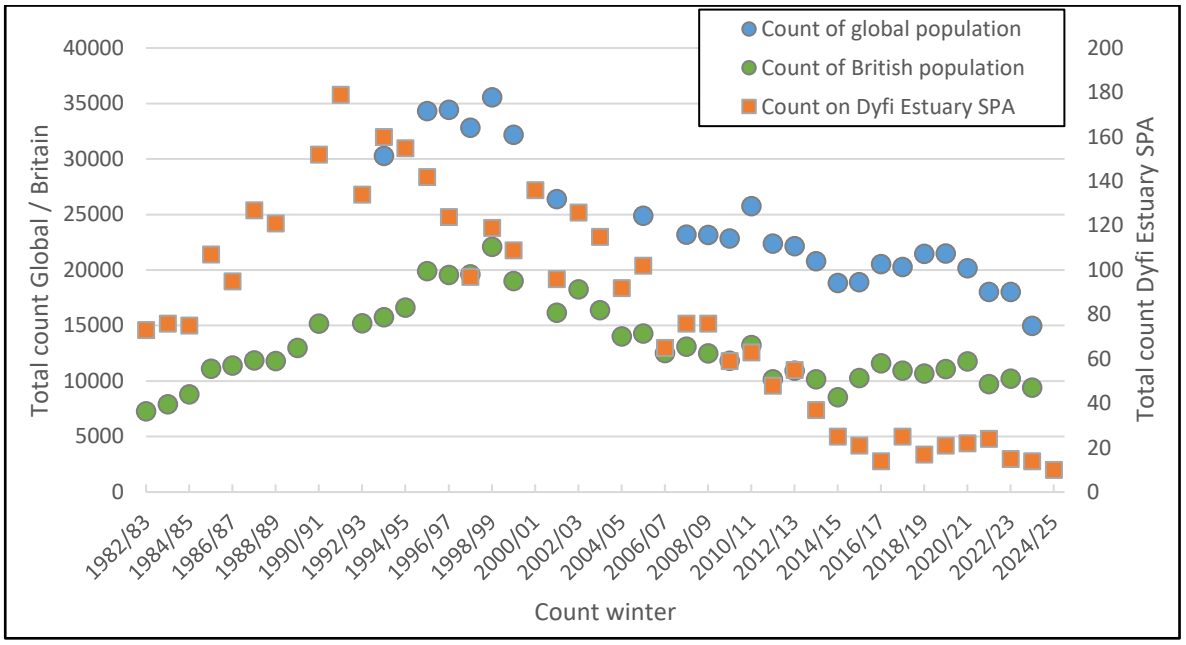
Regular co-ordinated counts of the global population started in the winter of 1982/83 following concerns that the population was in decline (Ruttledge and Ogilvie 1979). In the 1980s and 1990s there was an increase in the global population of Greenland white-fronted goose reaching a peak of 35,600 birds in spring 1999 (Stroud et al., 2012). Under protection from additive mortality from hunting and increased site safeguarding, the Greenland White-fronted Goose population increased by c. 6% per annum, generally faster at sites where flocks exploited high-energy agricultural crops (Fox, 2003, Fox et al., 2005, Fox et al., 2006). Since the late 1990s there has been a 57.8% decline in the global population to a total of 14,997 birds in spring 2024 which is the lowest number since co-ordinated counts of the population began in 1982 (Figure 2) (Fox et al., 2024). There was a decline in the global population of 16.8% between the spring 2023 and spring 2024 counts and 30.31% in the five years between the spring 2019 and spring 2024 counts (Fox et al. 2024).

The Dyfi Estuary SPA wintering population has shown a similar pattern to the global and British trends, and since the classification of the SPA in 2001 the wintering population has declined from 136 to 10 individuals in the winter of 2024/25. The rate of decline of the Dyfi Estuary SPA population has been at a greater rate than for the Irish and British populations (Figure 2). This is consistent with evidence that declines are greater for those wintering sites for Greenland white-fronted geese in the south-western part of the wintering range compared to the north-eastern sites (Schindler et al., 2024). It may also be due to smaller wintering populations tending to amalgamate with larger populations as Weegman et al. (2016) demonstrated that numbers at the Wexford wintering site are sustained by immigration from other smaller sites and Greenland white-fronted geese from the Dyfi Estuary SPA are known to move to and from Wexford (Mitchell et al., 2018).

The cause of this global decline in numbers is being driven by low rates of breeding success (Weegman et al., 2016; Weegman et al., 2017) and a decline in adult survival (Weegman et al., 2021), although there is limited demographic information for the Dyfi Estuary SPA population. A decline in productivity is likely related to changes in weather, specifically later spring snow fall, on the breeding grounds in west Greenland (Boyd and Fox, 2008). These factors operating on the breeding areas are outside the scope of management on the SPA. However in line with the AEWA ISSAP for this species there is an ecological functional need at the wintering sites to ensure that impacts, such as disturbance, are minimised to avoid the localised extinctions in the southern edge of the wintering range (Stroud et al., 2012).

The size of wintering population indicator failed to meet its target due to the low numbers of Greenland white-fronted goose and the rate of decline in the Dyfi Estuary population. The confidence is high as the over-wintering numbers in the Dyfi Estuary SPA are significantly below the target of greater or equal to 1% of the UK population.

Figure 2. Census count of Greenland white-fronted goose for the winters of 1982/83 to 2024/25. Data from GWFS and Fox et al., 2024. Counts for the Dyfi Estuary SPA for earlier years may be general winter counts rather than for the spring census date. Data not yet available for 2024/25 winter for British and global counts.



Winter survival / mortality rate

The target in the SPA management plan is for winter mortality rates to be less than 1% (CCW 2008). Data on winter mortality for the Dyfi Estuary SPA are limited to the last eight winters from 2017/18 to 2024/25 as previous to this there was limited consistent monitoring of the flock throughout the wintering period. Winter survival is estimated from changes in numbers of Greenland white-fronted geese during surveys on the Dyfi Estuary SPA.

Winter mortality is estimated to be higher than 1% in one of the six winters of the reporting cycle from 2019/20 to 2024/25 and two of the eight winters of available data. The low number of birds in the wintering population means loss of a single individual results in the mortality rate increasing above 1% (Table 4).

Reporting against this target is complicated by uncertainty in attributing loss of individual birds to mortality as opposed to movement to other wintering sites. Although this sub-species is generally loyal to wintering sites there are known to be within-winter movements between sites in addition to between-winter movements (Wilson et al., 1991, Warren et al., 1992). Individuals from the Dyfi Estuary SPA are known to have undertaken within-winter movements to Wexford, Ireland and between-winters movements to the Isle of Coll, Scotland (Mitchell et al., 2018). At the Wexford wintering site in Ireland Warren et al. (1992) estimated 2.8% of Greenland white-fronted geese undertook within-winter movements to and from other sites and a later study by Weegman et al. (2016) estimated that the population at the site was maintained by immigration of some 1400 birds per annum.

The Greenland white-fronted goose was a legal quarry species in Wales until it was removed from Schedule 2 of the Wildlife and Countryside Act 1981 in 2020. Prior to this there was a voluntary moratorium on shooting of the sub-species within the SPA but there is evidence of individuals being shot on the other Welsh wintering site on Ynys Môn/Anglesey until at least 2010 (Green and Mitchell, 2018). There is no current evidence of unlawful shooting on the Dyfi Estuary SPA.

The winter survival / mortality rate indicator has been assessed as unknown given the uncertainty of attributing loss of birds from the SPA wintering population to mortality or movement to other wintering sites.

Table 4. The winter mortality of Greenland white-fronted goose on the Dyfi Estuary SPA for each winter between 2017/18 and 2024/25.

Winter	**Winter mortality**
2024/25	No evidence of a decrease in numbers of Greenland white-fronted geese in the wintering flock between arrival in autumn and departure in spring.
2023/24	No evidence of a decrease in numbers of Greenland white-fronted geese in the wintering flock between arrival in the autumn and departure in the spring.
2022/23	One of the 16 individuals in the wintering flock of Greenland white-fronted goose was observed as absent from the flock from January onwards (presumed died) so the winter mortality was potentially >1% at 6.25%. The individual may however have emigrated to another wintering site.
2021/22	No evidence of a decrease in number of Greenland white-fronted geese in the wintering flock between arrival in the autumn and departure in the spring.
2020/21	No evidence of a decrease in number of Greenland white-fronted geese in the wintering flock between arrival in the autumn and departure in the spring.
2019/20	No evidence of a decrease in number of Greenland white-fronted geese in the wintering flock between arrival in the autumn and departure in the spring.
2018/19	No evidence of a decrease in number of Greenland white-fronted geese in the wintering flock between arrival in the autumn and departure in the spring.
2017/18	One of the 25 individuals in the in the wintering flock of Greenland white-fronted goose was observed as absent from the flock from March onwards (presumed died) so the winter mortality was potentially >1% at 4%. The individual may however have emigrated to another wintering site.

Proportion of juvenile geese to adults

The proportion of juvenile (first year) geese in the wintering population on the Dyfi Estuary SPA provides a measure of productivity and level of recruitment into the wintering population. This is in the absence of data on the breeding success of the SPA population in the remote breeding areas of west Greenland. The performance indicator target in the SPA management plan (CCW, 2008) is that the proportion of juveniles within the flock should not fall below 5% in any winter. The number of juvenile geese were counted during regular surveys of Greenland white-front geese within the SPA and distinguished from adult birds using the morphological differences of first year birds and the behaviour of these birds within family groups.

The target was not met in two of the six winters between 2019/20 and 2024/25 with no juveniles recorded in the SPA population in the winters of 2022/23 and 2023/24. In the four remaining winters the proportion of juvenile geese to adults was between 10 and 29% (Table 5). There was no evidence of a statistically significant decline (P=0.842) in the longer term trend (between 1982/83 and 2024/25) in the population of juvenile geese although there has been a significant decline in the percentage of juveniles in the wintering population in Britain over the same time period (P=0.038) (Figure 3). The absence of juveniles in two of the last six years, but no evidence of a longer term decline in breeding success within the SPA population, needs to be considered within the context of data on productivity in the global population.

Table 5. The percentage of juvenile Greenland white-fronted geese in the Dyfi Estuary SPA population in the winters between 2019/20 and 2024/25. Data from monitoring by NRW.

Winter	% juveniles in Dyfi Estuary SPA population	Number of birds in population
2019/20	9.5	21
2020/21	22.7	22
2021/22	29.2	24
2022/23	0	16
2023/24	0	16
2024/25	20.0	10

Productivity has declined at the largest Greenland white-fronted goose wintering site at Wexford (Weegman et al. 2017). Recruitment in the British and Irish wintering population fell below 5% for the first time in 40 years following the 2022 and 2023 breeding seasons (Fox et al., 2023, Fox et al., 2024) which are the two breeding seasons following which no juvenile geese were recorded in the Dyfi Estuary SPA wintering population (Table 5). Declining reproductive success is likely driven by climate change resulting in late snow fall and lie in the breeding areas of west Greenland, adversely impacting population

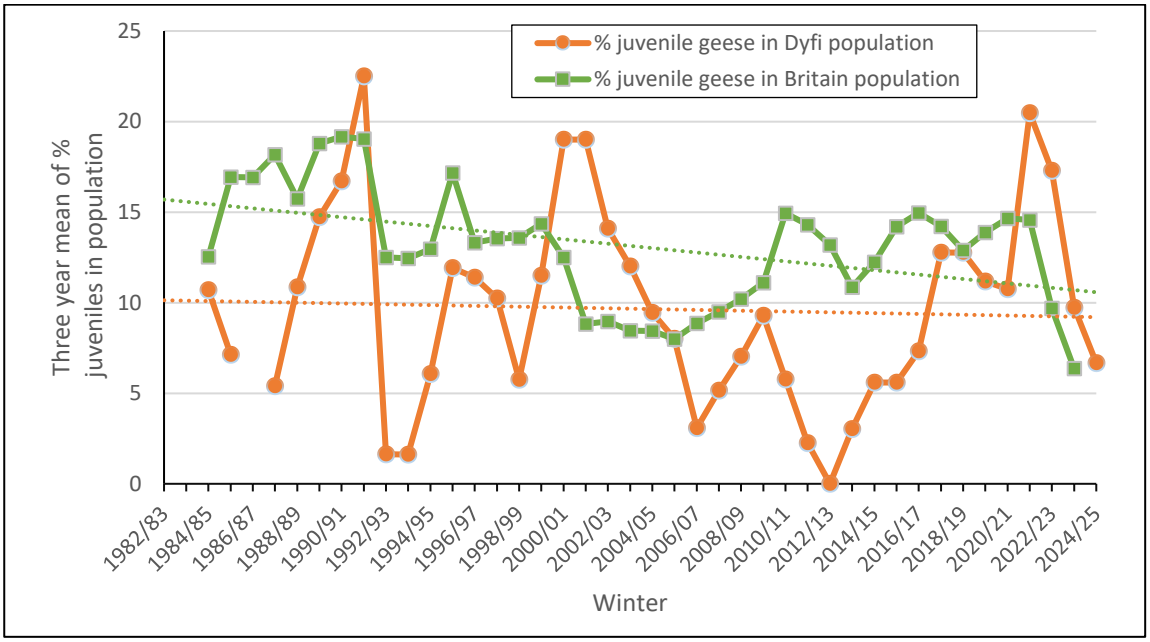
maintenance (Boyd and Fox, 2008). The poor productivity of the global population during the 2022 and 2023 breeding seasons coincided with late springs and late snow lie in the west Greenland breeding grounds (Fox et al. 2023; Fox et al. 2024). A study at Wexford, Ireland estimated that only 10% of individuals at that wintering site breed successfully in their life time (Weegman et al., 2016). The importance of the need to accumulate energy and nutrient stores prior to breeding to invest and allow successful reproduction is now widely accepted by goose experts. This consideration underlines the need for access to optimal food resources and reductions in human disturbance on the wintering grounds such as the Dyfi Estuary SPA.

The rate of decline in recruitment rate has been less in the Dyfi Estuary SPA population than the British population (Figure 3). Recruitment rates in the Dyfi Estuary SPA are likely more variable given the small numbers of individuals in the SPA flock which results in the proportion of juvenile birds in any year being determined by a small number of breeding pairs. For example, the 20% of juvenile birds in the SPA population in 2024/25 is the result of one pair of geese returning with two young in a total population of 10 birds.

A study by Schindler (2024) found geese at southwestern wintering sites such as the Dyfi were more adversely affected by harsh weather conditions on their breeding grounds (e.g. low temperatures and high precipitation as snow) because they tend to breed further north in Greenland, in addition to poor habitat conditions on their wintering grounds (i.e. low-quality grasslands and croplands).

The proportion of juvenile geese to adults indicator failed to meet its target with a high confidence because no juvenile geese were recorded in two of the last six winters. The two winters in which the target was failed, 2022/23 and 2023/24, corresponded with productivity in the global population being among the lowest on record.

Figure 3. The three-year mean of the percentage of juveniles in the Dyfi Estuary SPA and British wintering populations of Greenland white-fronted goose between 1982/83 and 2024/25. Data from GWFS and NRW.



Disturbance

Disturbance occurs when an activity is sufficient to disrupt normal behaviours, for example, changes to feeding or roosting behaviour. These changes may increase energy expenditure due to time spent moving to avoid stressors, temporary displacement or permanent desertion of supporting habitats (both within and outside the protected area). If the activity occurs at a level that substantially impacts behaviour for long enough it can lead to changes in distribution, desertion through reduction of available habitat available in undisturbed areas and consequently lead to negative impacts on the long-term viability of the population. Disturbance associated with human activity may take a variety of forms including, light, sound, vibration, presence of people, animals and structures.

Greenland white-fronted geese are known to be vulnerable to disturbance, with potential for local scale impacts (Goodship and Furness, 2022; Stroud et al., 2012). The AEWA ISAAP for the Greenland white-fronted goose identifies and advocates the need to avoid disturbance to roosting and feeding areas and the need for provision of disturbance free refuges. Norriss and Wilson (1988) showed that disturbance was an important factor affecting rates of Greenland white-fronted goose population change in Ireland, with flocks with a restricted feeding range being more likely to suffer local population declines as a result of disturbance..

Monitoring on the Dyfi Estuary SPA in the last six years has shown disturbance of Greenland white-fronted goose results from a number of sources including land management, railway management, aircraft and recreation (Fielding and Thomas, in prep). Recent progress has been made on identifying roosting locations and measures have

been taken to provide disturbance free buffers but some disturbance of roosting birds continues. It is likely that disturbance is a key driver of the observed home ranges of the geese on the SPA but it is uncertain at the site level how these pressures impact productivity, survival and emigration. Evidence from Schindler et al. 2024 suggests Greenland white-fronted geese that expended less energy and fed longer during the spring were more likely to successfully reproduce. Management within the SPA which leads to disturbance therefore has the potential to increase energy expenditure and reduce the likelihood of successfully breeding.

Greenland white-fronted geese also experience disturbance when using areas outside the SPA for feeding (Fielding and Thomas, in prep.) with few conservation mechanisms to control this disturbance. The Third SPA Review has identified that the spatial extent of the current SPA boundary needs review to potentially include additional areas for feeding or other functional needs (Grady et al., 2025). There are also few opportunities to provide voluntary incentives for goose friendly land management although future Welsh Government agri-environment schemes may deliver this.

The wintering population disturbance indicator failed to meet its target with a high confidence due to the direct monitoring of the population which has shown evidence of disturbance to Greenland white-fronted geese.

Supporting feeding habitat

The extent, distribution and availability of suitable habitat (either within or outside the SPA boundary) which supports the feature for all necessary ecological needs over the wintering period (*e.g.* roosting, feeding) are important to the condition of the Greenland white-fronted goose.

The sub-species is regarded as being closely associated with peatland habitat and the Dyfi population historically fed on Cors Fochno raised bog, which lies immediately to the south of the estuary, in addition to using upland lakes and bogs in north Ceredigion (Fox and Stroud, 1985). The geese wintering on the Dyfi Estuary SPA now predominantly feed on agriculturally improved grasslands managed for sheep and cattle grazing and saltmarsh vegetation. Availability and quality of feeding habitat is likely to be important in ensuring Greenland white-fronted geese can optimise feeding in spring and improve the likelihood of successful breeding (Schindler et al., 2024).

An unpublished NRW report (Mitchell et al., unpublished) suggested for the winters of 2016/17 and 2017/18 that there was no clear evidence of strong selection by the geese of particular in-field habitat types. In contrast to studies at the wintering site on Islay (Griffin et al. 2020), the study did not detect selection by the geese of improved and drained agricultural fields at the field level. In addition there was weak evidence of selection of relatively long swards. In both winters there was a strong switch around the start of February from feeding occasionally on saltmarsh to feeding largely on saltmarsh. Since then a study on diet selection has been conducted by a collaborative partnership under the ECHOES (Effect of climate change on bird habitats around the Irish Sea) project

(ECHOES 2023) but conclusions from this study were not available to inform this assessment.

Further evidence is needed to identify the characteristics of the vegetation which Greenland white-fronted goose are selecting on the SPA including how this relates to sward height and plant species. Sward height is known to be important in determining intake rates in geese (Durnat et al., 2003) and there is evidence that white-fronted geese select grass of 13-20cm (Vickery and Gill, 1999). The conservation objective in the management plan (CCW, 2008) is for sward height to be managed to be <15cm but there are no available data on whether this is being achieved. Therefore this indicator has been assessed as unknown.

Reasons for target failure

The assessment of the Greenland white-fronted goose feature in the Dyfi Estuary SPA failed three primary targets. This resulted in the feature to be assessed as being in **unfavourable** condition. The failing indicators and reasons for failure, if known, are stated below.

Over-wintering population

The performance indicator failed to meet its target for the Dyfi Estuary SPA with the numbers of birds in the over-wintering population significantly lower than the target. Over the last six winters between 2019/20 and 2024/25 there have been between 10 and 24 Greenland white-fronted geese present on the SPA, representing approximately 0.1% - 0.2% of the national (UK) wintering population instead of the target of greater than or equal to 1% of the UK population. The key driver of decreasing numbers of Greenland white-fronted geese on the SPA is likely to be poor productivity with the environmental cause related to changes in weather in spring on the breeding grounds. However the role of annual survival of adults or emigration to other wintering sites in the decline is unknown.

Proportion of juvenile geese to adults

The proportion of juvenile geese failed to meet its target of 5% of the SPA population in two of the last six years. This failure at the site level target assesses breeding productivity which has been declining in the global population for a number of years. The target failure is likely due to poor breeding success on the breeding grounds in Greenland rather than juvenile survival. The environmental driver of this low productivity is likely to be the changes in weather in spring on the breeding grounds.

Wintering population disturbance (by human activity)

Greenland white-fronted geese are known to be vulnerable to disturbance. Direct monitoring over the last six years has shown that the feature has been affected by anthropogenic disturbance although there have been improvements in reducing disturbance from some sources and in some areas of the SPA.

Threats to condition

Part of the condition assessment is to identify threats to the condition of the Greenland White-fronted goose on the Dyfi Estuary SPA. 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. Activities that go through licencing and permission process whereby the impact of the activity on the feature would be assessed have not been included. The threats to the Greenland white-fronted goose in Dyfi Estuary SPA are:

Climate change

It is not yet clear what pressures will be seen from climate change at the site level or how different pressures will counter act each other. However, threats from climate change that could impact the species at the site level are likely to include:

- Increased sea levels leading to coastal squeeze affecting the extent and quality of habitat required for feeding and roosting.
- Increasing sea levels and storminess leading to flooding and higher water levels with resulting impacts on land management and hence the extent and quality of feeding and roosting habitat. Winter flooding could also cause increased disturbance from operational responses to repair flood and rail infrastructure.
- Changes in the nutritional quality and extent of preferred food types due to increasing temperatures advancing spring growth of grass and subsequent phenology issues with fattening of geese prior to spring migration.

It is widely considered and accepted by goose experts that the key driver of population declines is poor overall breeding success possibly as a result of unseasonal snow fall and lie during the breeding season (Boyd and Fox, 2008, Stroud et al., 2012, Weegman et al., 2017).

Disease

Highly pathogenic avian influenza (HPAI) could be a threat to population viability especially given the low numbers of geese in the population on the Dyfi Estuary SPA. This virus is difficult to manage both at the SPA level and out-with the SPA due to the free moment of wild birds. Contingency plans need to be in place and incorporate strategies to manage the potential risks and threats from disease, for example by managing biosecurity measures. The rearing and management gamebirds in the locality also needs to adhere to biosecurity best practice.

Extent of SPA

As recognised in the Third UK SPA Review (Grady et al., 2025) the spatial extent of the Dyfi Estuary SPA does not encompass all key feeding areas used by Greenland white-fronted goose. This makes the feature vulnerable to future threats.

Evidence gaps

Evidence gaps that are needed to complete a high confidence condition assessment for this SPA are highlighted here.

Additional monitoring is required of the demographic mechanisms underlying the population decline on the Dyfi Estuary SPA, particularly evidence on annual survival rates and movements to other wintering sites such as Wexford and Anglesey. The small size of the population and the risk of causing disturbance and injury to geese however means mark-resighting studies to inform this monitoring would be challenging.

Additional evidence is required on how disturbance impacts on habitat selection, wintering site movements and fitness of Greenland white-fronted goose on the Dyfi Estuary SPA. Similarly additional evidence is required about how habitat use and fitness is impacted by feeding habitat availability and how this is influenced by availability of food plant species, sward structure and ground wetness.

Even though it is not critical for the condition assessment, as the assessment is based on what is happening at this SPA, more information on issues occurring off-site would be useful. For this sub-species this means evidence on issues at the breeding and staging sites in Greenland and Iceland that may be having an influence on demographic mechanisms for this SPA population.

Annual monitoring of all attributes should continue.

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