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WDC Shorewatch Programme coastal cetacean sightings data 2005-2023

Summary report of analyses

December 2025

Based on the full analysis found in:

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WHALE AND DOLPHIN CONSERVATION

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Reference

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Overview

The Whale and Dolphin Conservation (WDC) Shorewatch programme engages trained members of the public in monitoring coastal cetaceans in Scotland through dedicated, effort-based watches conducted from predetermined sites, using a standardised protocol. The programme aims to enhance our understanding of the species present, including their distribution and occurrence, while also identifying seasonal and year-to-year trends. It further seeks to promote public engagement with cetacean conservation and the protection of their marine habitats. This report presents updated analyses of cetacean occurrence along the Scottish coast, utilising data collected through the Shorewatch programme and building on previous work by Gutiérrez-Muñoz et al. (2021). It incorporates six additional years of data (2018 - 2023) and includes new Shorewatch sites, expanding the scope of the original study. The current analysis provides a more comprehensive understanding of spatiotemporal trends in cetacean distribution, utilising the expanded dataset to enhance insights into seasonal and regional patterns of occurrence.

The primary aims of this updated analysis are to describe and quantify patterns and trends in the local and regional occurrence of cetaceans, including assessing the influence of environmental factors on species presence. Additionally, the study evaluates the effectiveness of the Shorewatch Programme as a cetacean monitoring tool, highlighting the value of citizen science in filling critical data gaps, and providing essential insights for conservation and management. These findings emphasise the need for continued broad-scale monitoring to support effective cetacean conservation in Scottish waters.

Key Findings

Key patterns and trends were identified through the expanded core sites analysis (now comprising 14 different sites around the Scottish coastline) and new regional analysis (incorporating data from all sites) for the following seven species:

- **Bottlenose dolphin** occurrence declined in the Moray Firth, possibly reflecting a southward distribution shift. Occurrence peaked seasonally in summer across all sites.
- **Harbour porpoise** occurrence peaked seasonally in autumn. In the West Highland region, occurrence peaked in 2016 before declining; in Forth & Tay, occurrence increased.
- **Minke whale** sightings peaked seasonally in June-July, with Tiumpan Head (Isle of Lewis) identified as an occurrence hotspot.
- **Risso's dolphin** occurrence showed a seasonal peak in late summer, with a confirmed hotspot at Tiumpan Head. Recent observations hint that Latheronwheel (NE Moray Firth) may also be a hotspot, but this was not detected in the analysis and remains preliminary.
- **Common dolphin** occurrence was highest in the Outer Hebrides and West Highlands, and showed a seasonal peak in summer.
- **Humpback whale** occurrence showed a seasonal peak in late autumn and winter at the regional scale.
- **White-beaked dolphin** occurrence peaked seasonally in June-July, with notable seasonal fluctuations.

Risso's dolphin *(Grampus griseus)*

Moreover, this analysis considers the appropriateness of the programme for monitoring by:

- Highlighting emerging sites of interest (Kilt Rock and Rhue Lighthouse) along with confirming the importance of previously identified sites, such as Tiumpan Head and Chanonry Narrows.
- Underscoring the need for sustained and evenly distributed effort to improve the reliability of analyses, particularly for less frequently observed species.
- Demonstrating the potential for regional analysis to provide valuable insights for monitoring using Scottish Marine Regions (SMRs) as a framework, but suggests the possibility of exploring different scales of interest (MPAs, IMMAs, MUs).
- Evidencing the adaptability of the Shorewatch programme to address data gaps, such as data collection during winter months toward improved understanding of seasonal patterns.
- Suggesting the importance of integrating Shorewatch data with other survey data to provide increased temporal coverage, coastal spatial coverage, and to inform targeted conservation efforts and appropriately sited offshore developments.

WHALE AND DOLPHIN CONSERVATION WDC

1. Introduction

The WDC Shorewatch Programme is designed to provide systematic, effort-based, and ongoing monitoring of cetaceans around the Scottish coast, identifying local and regional patterns in species presence, seasonal variation, and long-term trends. It aims to fill critical data gaps, particularly in data-deficient areas or seasons that may not be covered by other broad-scale survey efforts. The programme contributes valuable data on the presence, distribution, and seasonality of cetacean species in Scottish coastal waters to inform conservation and management strategies, including supporting the identification of areas of important habitat for cetaceans, future incorporation into assessments of Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD), and the integration of citizen science data into existing marine biodiversity monitoring frameworks.

This report presents updated analyses of cetacean occurrence along the Scottish coast, utilising data collected through the Shorewatch programme and building on previous analysis by Gutiérrez-Muñoz et al. (2021). It incorporates six additional years of data (2018-2023) and includes new Shorewatch sites, notably extending coverage around the coast and, for the first time, in the Northern Isles, thereby expanding the scope of the original study.

These updated analyses aim to provide a more comprehensive understanding of spatiotemporal trends in cetacean distribution, utilising the expanded dataset to enhance insights into seasonal and regional patterns of occurrence. Specifically, it aims to:

- describe and quantify patterns and trends in the local and regional occurrence of cetaceans, including assessing the influence of environmental factors on species presence;
- evaluate the effectiveness of the Shorewatch programme as a cetacean monitoring tool, highlighting the value of citizen science in filling critical data gaps;
- provide essential insights to help assess the conservation status of cetacean populations, as required under relevant conservation legislation.

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2. Methodology

The first Shorewatch occurred at the WDC Scottish Dolphin Centre on 19th March, 2005 at 15.05

2.1 Data collection

Each Shorewatch survey follows a structured protocol whereby trained community volunteers record key environmental and sightings-specific variables during 10-minute observation periods. This includes noting the location, date, and start and end times of the watch, as well as the sea state and visibility conditions, along with the identity of the observer to ensure quality control in data reporting. Volunteers document the presence of cetaceans, identifying the species, recording the number of individuals, and categorising basic behaviours. Additionally, observations of seabirds and vessels are recorded. Casual ("off-effort") sightings are logged separately to capture any relevant observations outside of the formal Shorewatch surveys and locations. Further methodological details can be found in Gutiérrez-Muñoz et al. (2021) and Rodriguez-Mendoza et al. (2025).


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Data collection began at the WDC Scottish Dolphin Centre in Spey Bay in 2005. Starting in 2009, other sites were added around the Scottish coast. By 2023, there were 60 active Shorewatch sites (Figure 1, see p9).

The Shorewatch programme's methodology emphasises effort-standardisation, which is crucial for ensuring data reliability. Volunteer training and fixed observation methodology maintain consistency across watches, while intervals between consecutive watches help to prevent duplicate sightings of the same individuals and observer fatigue. Additionally, fixed locations for monitoring sites provide a long-term, stable dataset for detecting trends. These rigorous protocols have contributed to the high quality of the data collected.

However, it is important to acknowledge potential biases in the data. Observations from land are evidently spatially limited to coastal areas, and effort is unevenly distributed across different sites and seasons. While species misidentification is a common challenge in citizen science projects, the robust training and ongoing support for Shorewatch volunteers aims to mitigate this risk, ensuring the data remains of high quality as confirmed by the initial analysis (Gutiérrez-Munoz et al., 2021).

2.2 Data Analysis

An overview of the data analysis techniques is described here. Decision and details about data preparation and analysis are outlined in full in Rodríguez-Mendoza et al. (2025). Data exploration and analysis were conducted in R (R-4.4.2, R Core Team, 2024).

The full dataset was examined to describe and visualise the spatial distribution (across sites) and temporal patterns (yearly and seasonal) of watch effort. This allowed the selection of sites and time periods with sufficient data for statistical analyses, while also highlighting locations and times where and when increased effort might be beneficial. The sightings data were also reviewed to identify the most frequently observed species and the overall spatial and temporal distribution of cetacean sightings, considering all species combined. (Evidently this could also be done by species.)

Following data familiarisation, subsequent analyses were carried out to identify trends in cetacean occurrence across different temporal and spatial scales. These analyses aimed to assess patterns in cetacean occurrence and the efficacy of the Shorewatch programme as a monitoring tool; they are described fully in Rodríguez-Mendoza et al. (2025). The following are presented in this report:

1. **Core Sites Analysis**
2. **Regional (SMR) Analysis**
3. **Northern Isles Preliminary Analysis**

It should be noted that various aspects of the data collection methodology that were evaluated in the previous analysis of Shorewatch data (see Gutierrez-Muñoz et al., 2021) were not re-evaluated in this study. These included the consistency of species identification, the statistical properties of the data (e.g. existence of autocorrelation), and the precision of the estimates of probability of occurrence. That earlier analysis, coupled with statistical simulations based on the results, demonstrated the methodology's power to detect trends and its potential to contribute to assessing GES under MSFD or to monitor human impacts on coastal cetaceans at a fine scale.

common dolphin *(Delphinus delphis)*

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Overview of Analyses

1 The **Core Sites Analysis** focused on the sites that had reached the minimum required level of effort for robust statistical analysis, as outlined in Gutiérrez-Munoz et al. (2021). Using data from 2017-2023, this analysis included data from 14 sites (an increase from six core sites contributing to the 2012-2017 Core Sites Analysis).

2 For the first time with this data set, a **Regional (SMR) Analysis** was undertaken which allowed inclusion of survey data from sites which did not achieve the minimum effort requirements to be incorporated into the core site analyses. Data were grouped, based on Scottish Marine Regions (SMRs) to explore potential regional trends.

3 **Northern Isles Preliminary Analysis**. Sites in the Northern Isles (Orkney and Shetland) were incorporated into the programme more recently, resulting in a shorter time series (2021-2023) that did not meet the minimum requirement of six years. However, a preliminary analysis was conducted separately to assess the potential of Shorewatch in this pilot regions.

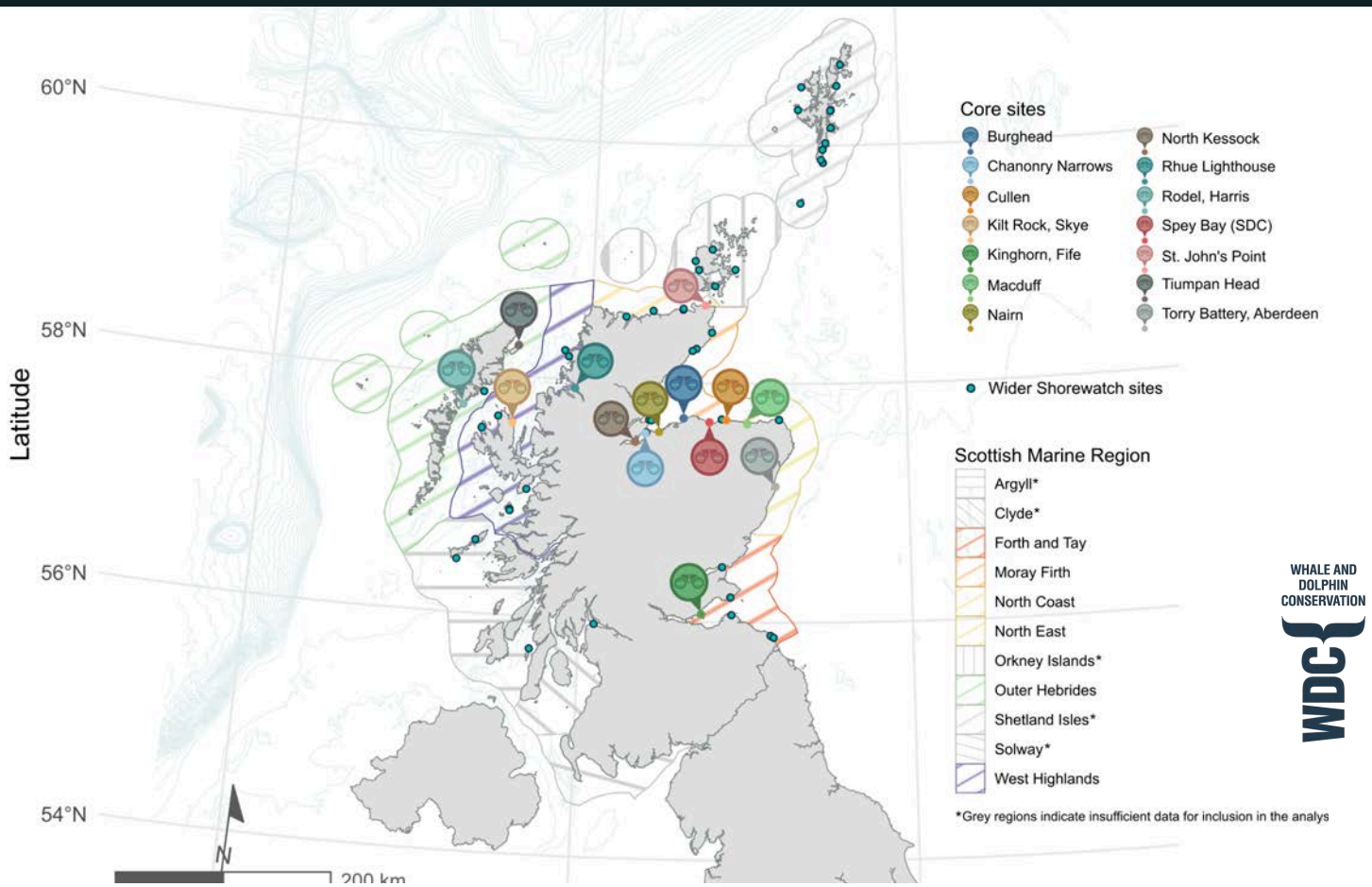

Figure 1. Map of survey locations identifying by name and colour the 14 sites used for the Core sites analysis along with the wider Shorewatch sites (turquoise circles) that supplement the core data for the Regional analysis. The regional analysis encompasses all core and supplementary sites within the six Scottish Marine Regions (Forth and Tay, Moray Firth, North Coast, North East, Outer Hebrides and West Highlands) where sufficient data was collected. See Rodriguez-Mendoza et al. (2025) for a complete list of the individual sites processed for inclusion in each analysis. Note that the data from the Northern Isles (Orkney Islands and Shetland Isles) were analysed separately because these sites were incorporated in the Shorewatch Programme more recently, resulting in a considerably shorter time series spanning three years (2021-2023).

2.2.1 Core Sites Analysis

The Core Sites Analysis expanded on the work outlined in Gutierrez-Muñoz et al. (2021) by incorporating data from eight additional monitoring sites with good seasonal coverage (i.e., at least 20 watches per month) over at least six years, bringing the total to 14 Shorewatch sites across Scotland (Figure 1). These sites included Rodel and Tiumpan Head (Outer Hebrides), Kilt Rock (Skye) & Rhue Lighthouse (West Highland); St John's Point (North Coast) Burghead, Chanonry Narrows, Cullen, Macduff, Nairn, North Kessock and Spey Bay (all Moray Firth); Torry Battery Aberdeen (North East); and Kinghorn, Fife (Forth and Tay). By analysing data collected from 2017 to 2023, this approach provided a more comprehensive understanding of cetacean occurrence trends across a broader geographic range. Data were aggregated by site-date units for analysis to account for possible temporal autocorrelation between watches conducted within the same day, resulting in 14,196 unique site-date combinations. Observations made under unfavourable weather conditions (i.e., sea states of 5 or higher or visibility less than 1 km) were excluded. Generalised additive mixed models (GAMMs) were fitted to analyse patterns and trends in the local occurrence of the five most frequently sighted species:

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(i) bottlenose dolphin (Tursiops truncatus), (ii) harbour porpoise *(Phocoena phocoena)*, (iii) minke whale *(Balaenoptera acutorostrata)*, (iv) Risso's dolphin *(Grampus griseus)*, and (v) common dolphin *(Delphinus delphis)*. In this case, the variable "site" was used as the random effect. Occurrence of each species was the response variable, with environmental and temporal variables as explanatory variables. Details of the methodology for modelling patterns and trends in occurrence are provided in 2.2.4 below.

2.2.2 Regional (SMR) Analysis

For the Regional analysis, data were grouped according to the Scottish Marine Regions (SMRs), as determined in the Scottish Marine Regions Order 2015.[2] The Scottish Marine Regions consist of 11 areas established for the purposes of regional marine planning, and include sub-areas of both the "Scottish marine area" defined in the Marine (Scotland) Act 2010 and the "Scottish inshore region" defined in the Marine and Coastal Access Act 2009.[3] It should be noted that other regional divisions could have been used, such as Marine Protected Areas (MPAs) or Important Marine Mammal Areas (IMMAs), which are defined as discrete portions of habitat, important to marine mammal species (NatureScot, 2024; IUCN-MMPATF, 2024) (see also Section 4. Discussion). However, use of SMRs was selected here to test this analysis methodology as it provides a more complete and representative coverage of the Scottish coast than would arise by selecting discrete "protected" or "important" areas that are adjacent to Shorewatch sites.

2 The order is available via http://www.legislation.gov.uk/ssi/2015/193/contents/made

3 https://www.data.gov.uk/dataset/f9ef823d-e672-4f35-8f00-41480dad7bf2/administrative-units-scottish-marine-regions-smrs

Shorewatch data from six regions were used in the analysis (N = 83 591): (i) Outer Hebrides, (ii) West Highlands, (iii) North Coast, (iv) Moray Firth, (v) North East and (vi) Forth and Tay. The selection of these regions was because they had relatively long time series of data (i.e., 2012-2023), although Forth and Tay region has a gap during the period 2014-2017. Northern Isles SMRs (Orkney Islands and Shetland Isles) were not included in this analysis because the time series is considerably shorter (only three years, from 2021-2023).

Data were aggregated by region and date for analysis to account for possible temporal autocorrelation, resulting in 12,142 unique region-date combinations. Observations made in poor weather conditions (sea state 5+ or visibility below 1 km) were excluded. Statistical modelling focused on trends in the seven most frequently recorded species: (i) bottlenose dolphin, (ii) harbour porpoise, (iii) minke whale, (iv) Risso's dolphin, (v) common dolphin, (vi) humpback whale (*Megaptera novaeangliae*) and white-beaked dolphin (*Lagenorhynchus albirostris*). The inclusion of the latter two species was justified when data were grouped at regional level but it should be noted that both had relatively low occurrences (144 and 137 records, respectively). Generalised additive models (GAMs) were used to assess environmental and temporal influences on species presence. Full methodological details are provided below.

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2.2.3 Northern Isles Analysis

The Northern Isles (Orkney Islands and Shetland and Fair Isle SMRs) were analysed separately due to the shorter time series of data available (2021–2023), which does not yet meet the six-year minimum required for inclusion in the core Shorewatch analysis. Due to this limitation, a separate regional analysis was conducted, aiming to assess the programme's potential to provide insights into cetacean occurrence patterns in the pilot study regions. This preliminarily statistical modelling focused on the two most regularly sighted species, harbour porpoise and minke whale. Analysis for other species will be conducted once there are sufficient data. Binomial GAM models were developed for each species to explore patterns in occurrence. These results should be interpreted with caution due to the shorter data series. For full methodology and results, see Rodríguez-Mendoza et al. (2025).

minke whale *(Balaenoptera acutorostrata)*

2.2.4 Modelling patterns and trends in cetacean sightings

To investigate the influence of temporal and environmental variables on coastal cetacean occurrence, Generalised Additive (Mixed) Models (GAMs/GAMMs) were fitted for each species separately using the mgcv library in R (version1.9-1; Wood, 2017; R-4.4.2, R Core Team, 2024). Presence/absence of the species for each site-day (2023 core site analysis) or region-day (regional analysis) was the response variable, using a binomial distribution. Explanatory variables from the Shorewatch data set and other environmental variables used in the models are outlined in Tables 1 and 2.

The final selection of variables varied between models, as some predictors were correlated and could not be included simultaneously. To decide which variable to retain, we compared alternative models using the Akaike Information Criterion (AIC). The model with the lowest AIC value was chosen, as it represents the best balance between goodness of fit and model simplicity among the candidate options. In the Core Sites Analysis, site number was included as a categorical random effect to handle overall non-independence of observations within sites and account for unexplained differences between sites due to different baseline probability of occurrence. For environmental variables, maximum number of knots used for non-linear terms was set to four to prevent overfitting. Model selection was carried out using stepwise backwards selection, starting from full models containing all possible explanatory variables, and subsequently eliminating non-significant terms one at a time, starting with the least important in the model. Further details on the GAM/GAMM models are provided in Rodríguez-Mendoza et al. (2025).

Variable	Units
Observation site	Categorical
Scottish Marine Region (SMR)	Categorical
Date	Days
Month	No. of month (1-12)
Year	Year
Watch start time	Minutes
Sea state	Beaufort code
Visibility	km
Height of observation platform	m

Table 1. Explanatory variables from the Shorewatch dataset considered for the models.

Variable	Units	Spatial resolution	Temporal resolution
Bathymetry (as mean depth)	m	30 arc-seconds	Static
Seabed slope	degrees		
Seabed aspect	degrees		

Table 2. Other environmental variables considered in the models. Source for all: General Bathymetric Chart of the Oceans 30 arc-second database, GEBCO (Becker et al., 2009) http://gebco.net

3. Results

Between 2012 and 2023, the Shorewatch programme amassed a substantial dataset comprising 83,335 watches and over 13,889 hours of observational effort. Across this period, 19 cetacean species were recorded at sites distributed throughout Scotland's coastal waters. Fourteen monitoring locations met the criteria to be designated as Core Sites, enabling robust trend analysis for five frequently observed species: bottlenose dolphin, harbour porpoise, minke whale, Risso's dolphin, and common dolphin. In addition to site-level analyses, data were aggregated by Scottish Marine Regions (SMRs) to explore broader spatial patterns. Six regions contributed sufficient time series for regional modelling, and this analysis enabled the investigation of occurrence patterns for two further species: humpback whale and white-beaked dolphin. These findings are summarised below, with full methodological details and extended results presented in Rodríguez-Mendoza et al. (2025).

3.1 Temporal and Spatial Trends

This section presents the results of binomial models used to investigate the occurrence patterns of seven cetacean species commonly found in Scottish coastal waters. Each species exhibits distinct seasonal behaviours and habitat preferences that influence their distribution. Seasonal and year-to-year patterns were also explored. Key findings include identifying sites with a high probability of occurrence and seasonal peaks for each species.

The models evaluated the influence of environmental factors (e.g. sea state, visibility, and aspect) and observation effort (e.g. duration) on the probability of cetacean occurrence. Graphs of model predictions illustrate how individual factors affect where and when species are likely to occur, offering insights into their habitat use. Model specifications and results for each species within the analyses carried out are shown in *Annex 1* and more fully described in Rodriguez-Mendoza et al. (2025).

It is important to note that sightings were unevenly distributed across the 14 sites, with some species mainly observed at specific locations.

The number of site-date combinations (i.e., instances where a site was surveyed on a specific date, regardless of whether the species was observed) and the number of positive records (i.e., confirmed sightings of bottlenose dolphins) are provided by species for each observation site. Highlighted sites had a particularly strong influence on the analysis. These locations contributed disproportionately to the overall trends discussed in the report, due to either high sighting frequency or consistent presence of the species.

This summary report highlights key trends across year, month, site, and region for each species. For a full investigation of explanatory variables used, model selection, and results, please see Rodriguez-Mendoza et al. (2025).

Bottlenose Dolphin

Patterns and Trends

This two-page summary presents results from recent analyses of Shorewatch data exploring trends in bottlenose dolphin occurrence across Scotland. It includes findings from the Core Sites Analysis (2017-2023) and the Regional Scottish Marine Regions (SMR) Analysis (2012-2023), both supported by relevant figures and tables, and provides additional context from wider research. For full methodology and results, see Rodríguez-Mendoza et al. (2025).

Key Findings

Bottlenose dolphin occurrence declined in the Moray Firth, possibly reflecting a southward distribution shift. Occurrence peaked seasonally in summer.

Core Sites Analysis

Bottlenose dolphin occurrence showed strong spatial and seasonal patterns across the 14 core observation sites. The highest probabilities of sightings were concentrated in the Moray Firth, particularly at Spey Bay, Chanonry Narrows, and Torry Battery, which together accounted for the majority of positive records (Table BND & Figures BNDa/b). Seasonal trends revealed a peak in occurrence during June, with higher occurrence in the evening and under favourable sea states and visibility. Longer observation efforts also increased the likelihood of sightings. A slight downward trend over time was noted, although the effect of year was weak (Figure BNDc).

The most influential variable was site, explaining nearly 29% of the deviance (variation), followed by month and effort duration. The model performed well, with an adjusted R^2 of 0.378 and a correlation of 0.874 between observed and fitted values. For a full review of the analysis, please see Rodriguez-Mendoza et al. (2025).

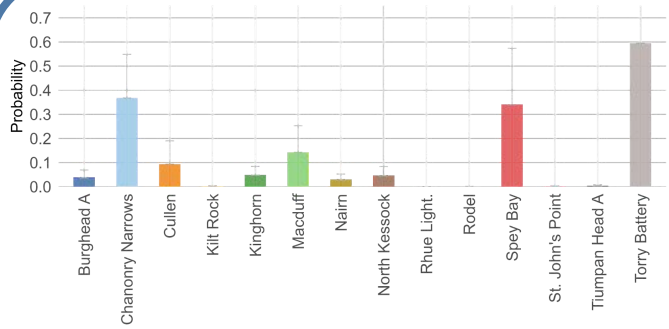

Figure BNDa. Mean predicted bottlenose dolphin probability of occurrence at each site. Error bars indicate one standard deviation of those predictions.

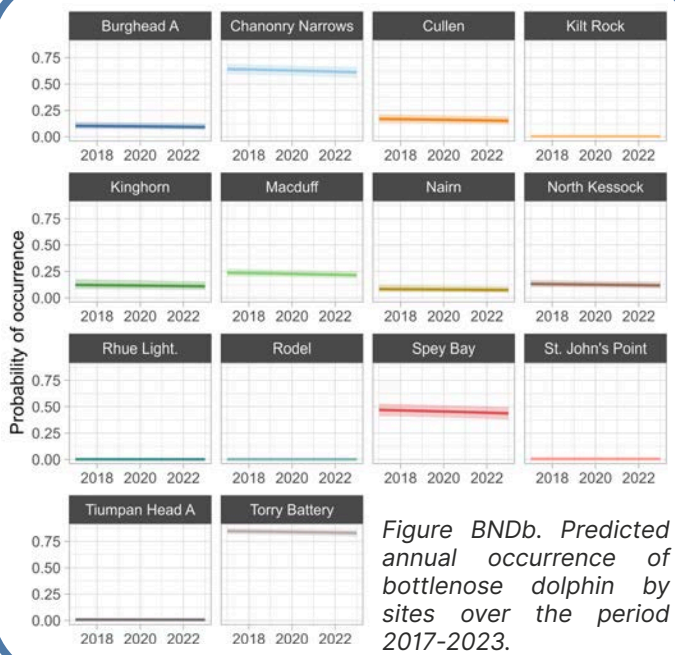

Figure BNDb. Predicted annual occurrence of bottlenose dolphin by sites over the period 2017-2023.

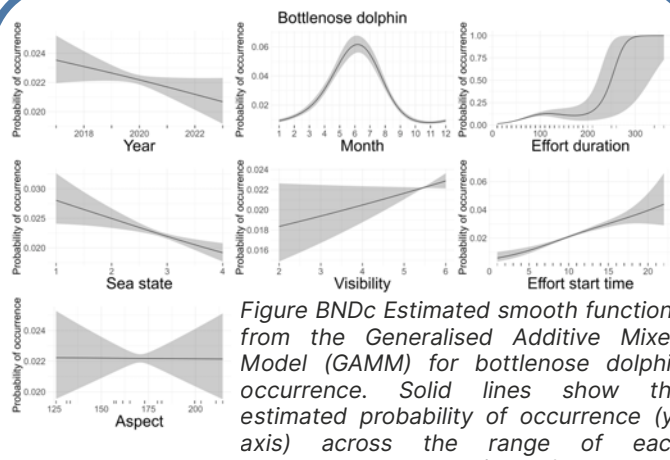

Figure BNDc Estimated smooth functions from the Generalised Additive Mixed Model (GAMM) for bottlenose dolphin occurrence. Solid lines show the estimated probability of occurrence (y-axis) across the range of each explanatory variable (x-axis), with 95% confidence intervals shaded in grey.

Site name	Burghead	Chanonry Narrows	Cullen	Kilt Rock, Skye	Kinghorn, Fife	Macduff	Nairn	North Kessock	Rhue (Ullapool)	Rodel, Harris	Spey Bay (SDC)	St. John's Point	Tiumpan Head	Torry Battery (Aberdeen)
Site-date combinations	N = 927	N = 1434	N = 856	N = 905	N = 500	N = 2031	N = 651	N = 1558	N = 821	N = 430	N = 1484	N = 585	N = 800	N = 1214
Nr. of positive records	N = 41	N = 543	N = 83	N = 2	N = 26	N = 288	N = 24	N = 72	N = 0	N = 0	N = 546	N = 1	N = 4	N = 722
Scottish Marine Region (SMR)	Moray Firth	Moray Firth	Moray Firth	West Highlands	Forth and Tay	Moray Firth	Moray Firth	Moray Firth	West Highlands	Outer Hebrides	Moray Firth	North Coast	Outer Hebrides	North East

Table BND. Site-date combinations (instances where a site was surveyed on a specific date, regardless of whether the species was observed) and the number of bottlenose dolphin positive records at each site. Sites highlighted in colour had a particularly strong influence on the analysis. These locations contributed disproportionately to the overall trends in the report, due to either high sighting frequency or consistent species presence.

Bottlenose Dolphin

Patterns and Trends

Regional SMR Analysis

At the regional scale, bottlenose dolphin occurrence was highest in the Moray Firth and North East Scottish Marine Regions (SMRs). In the Moray Firth, a declining trend was observed over the years, while the North East region showed a slight increase from 2016 to 2020, followed by a slight decline (Figures BNDd/BNDe). Seasonal variation was consistent with Core Site findings, with highest occurrence in June and lowest occurrence between September and March.

Survey effort duration was a significant predictor, and occurrence was more likely during midday and early afternoon (Figure BDNf). The regional model explained 50% of the deviance, with Year, SMR, and their interaction contributing the most (approx. 36%). The adjusted R^2 was 0.521, indicating a reasonably good model fit.

Sites in Orkney and Shetland haven't yet met the 6-year data requirement for the main analysis. Data from these regions were reviewed separately and should be interpreted carefully, but early findings are promising (see Northern Isles preliminary analysis).

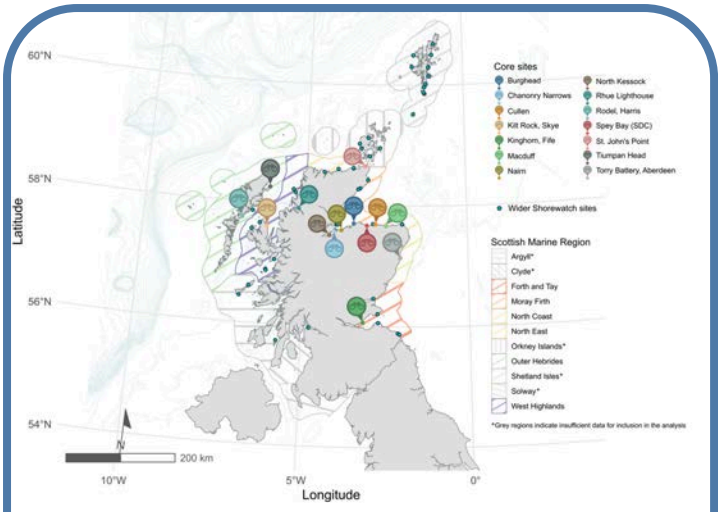

Figure SW Map. Showing the active observation sites of the Shorewatch Programme. Core sites and Scottish Marine Regions (SMRs) are highlighted.

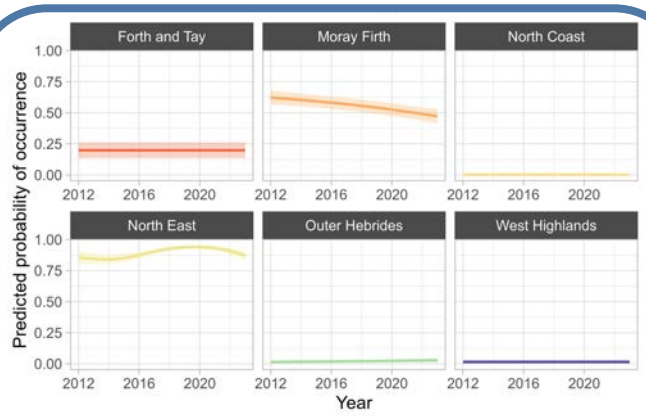

Figure BNDe. Predicted annual bottlenose dolphin probability of occurrence for the six Scottish Marine Regions over the period 2012-2023.

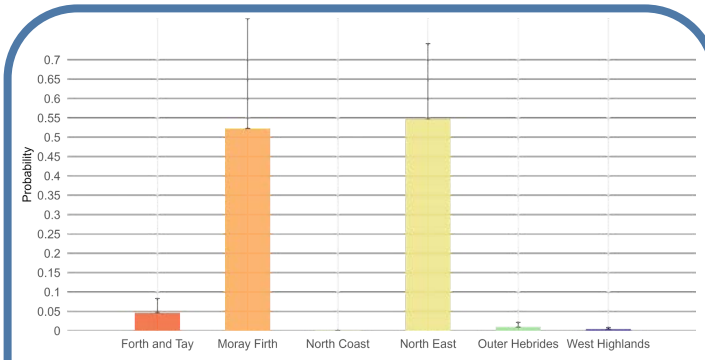

Figure BNDd. Predicted bottlenose dolphin probability of occurrence with standard deviations for the six Scottish Marine Regions with sufficient effort.

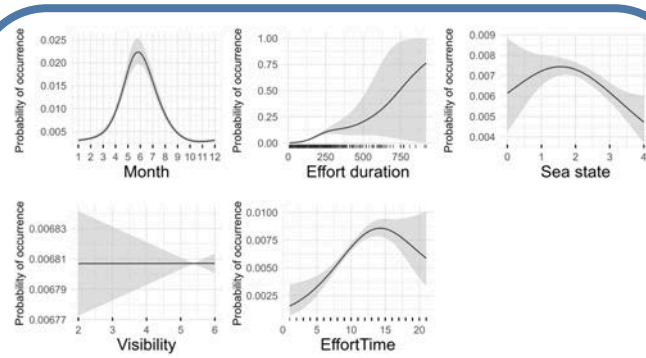

Figure BNDf GAM smoother plots for bottlenose dolphin occurrence for the variables month, effort duration, sea state, visibility, and effort start time. For each smoother plot, the y-axis shows the probability of occurrence, and the X-axis indicates the values of the explanatory variables.

Discussion

Shorewatch data confirm the Moray Firth and North East regions as key areas for bottlenose dolphin occurrence, with consistent seasonal peaks in June and strong site-level effects at Spey Bay, Chanonry Narrows, and Torry Battery. However, a slight but persistent decline in occurrence was observed, particularly in the Moray Firth, aligning with wider studies (Hackett 2022) and suggesting a southward expansion in distribution. This trend is supported by photo-ID studies showing individuals previously recorded in the Moray Firth now regularly sighted along the Northumbrian and Yorkshire coasts (Cheney et al. 2024), which has been recognised through IMMA (IUCN-MMPATF 2024) and OSPAR Quality Status Reporting (Geelhoed et al. 2022). The Citizen Fins photo-ID project further highlights the importance of public contributions in tracking this expansion into under-surveyed areas. As such, sustained Shorewatch effort at established sites, continued monitoring in emerging areas like Kinghorn, and enhancing effort in newer sites along the southeast Scottish and northeast English coastline are essential to track distribution changes and support conservation assessments under the Marine Strategy Framework Directive.

Harbour Porpoise

Patterns and Trends

This two-page summary presents results from recent analyses of Shorewatch data exploring trends in harbour porpoise occurrence across Scotland. It includes findings from the Core Sites Analysis (2017-2023) and the Regional Scottish Marine Regions (SMR) Analysis (2012-2023), both supported by relevant figures and tables, and provides additional context from wider research. For full methodology and results, see Rodríguez-Mendoza et al. (2025).

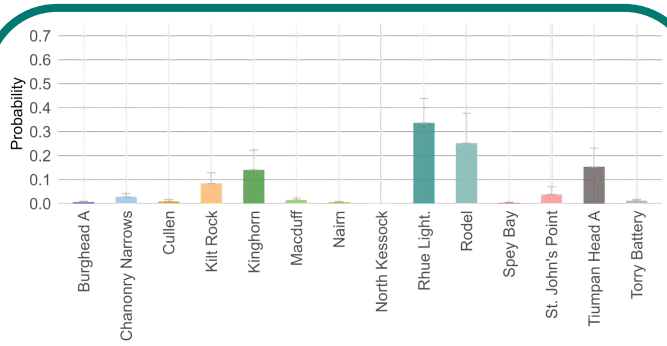

Figure HPa. Mean predicted harbour porpoise probability of occurrence at each site. Error bars indicate one standard deviation of those predictions.

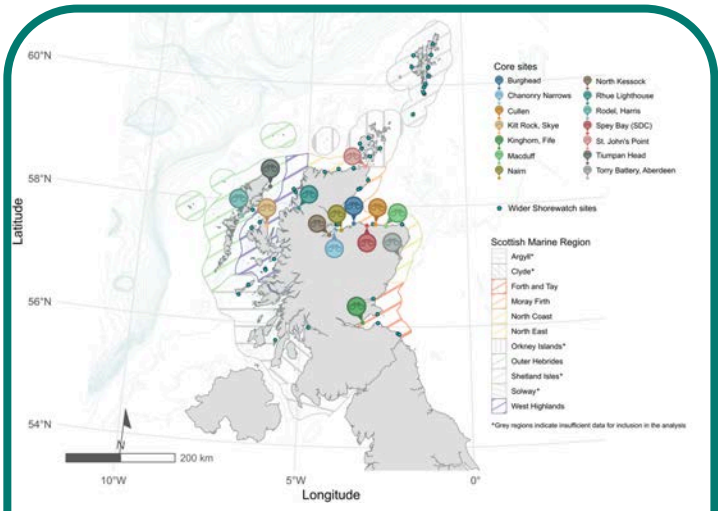

Figure SW Map. Showing the active observation sites of the Shorewatch Programme. Core sites and Scottish Marine Regions (SMRs) are highlighted.

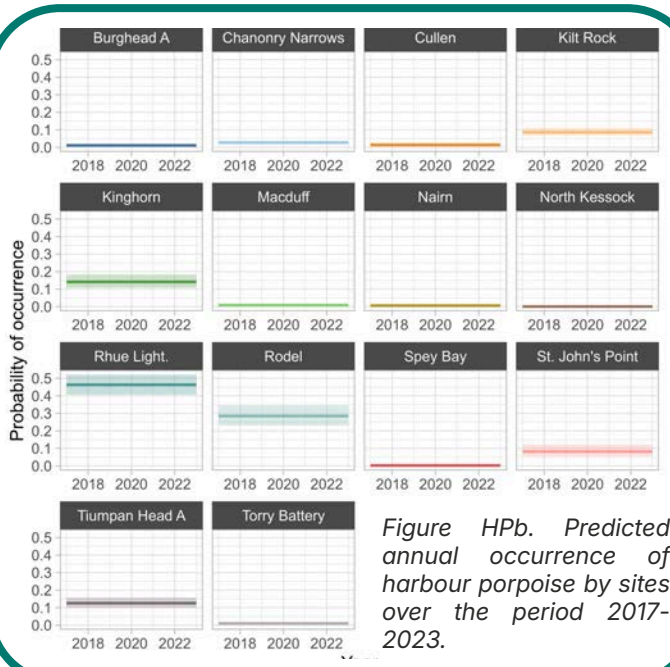

Figure HPb. Predicted annual occurrence of harbour porpoise by sites over the period 2017-2023.

Core Sites Analysis

Harbour porpoise occurrence was most frequent at Rhue (Ullapool), Tiumpan Head (Lewis), Kilt Rock (Skye), and Rodel (Harris). These sites contributed the highest number of positive records and strongly influenced the overall trends (TableHP, Figures HPa/b). Seasonal patterns showed a peak in October, with the lowest occurrence around March. Sightings were more likely during longer observation periods, in calmer sea states, and were slightly more probable in the evening (Figure HPc).

The model showed no significant change in occurrence over time. Site was the most influential variable, explaining 24.91% of the deviance, followed by sea state and effort duration. The model had an adjusted R^2 of 0.28 and a correlation of 0.739 between observed and predicted values.

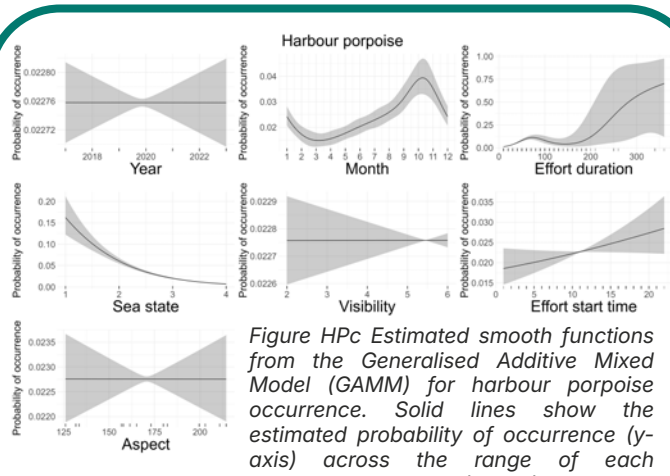

Figure HPc Estimated smooth functions from the Generalised Additive Mixed Model (GAMM) for harbour porpoise occurrence. Solid lines show the estimated probability of occurrence (y-axis) across the range of each explanatory variable (x-axis), with 95 % confidence intervals shaded in grey.

Site name	Burghead	Chanonry Narrows	Cullen	Kilt Rock, Skye	Kinghorn, Fife	Macduff	Nairn	North Kessock	Rhue (Ullapool)	Rodel, Harris	Spey Bay (SDC)	St. John's Point	Tiumpan Head	Torry Battery (Aberdeen)
Site-date combinations	N = 927	N = 1434	N = 856	N = 905	N = 500	N = 2031	N = 651	N = 1558	N = 821	N = 430	N = 1484	N = 585	N = 800	N = 1214
Nr. of positive records	N = 9	N = 63	N = 10	N = 116	N = 92	N = 41	N = 5	N = 0	N = 291	N = 124	N = 6	N = 25	N = 151	N = 21
Scottish Marine Region (SMR)	Moray Firth	Moray Firth	Moray Firth	West Highlands	Forth and Tay	Moray Firth	Moray Firth	Moray Firth	West Highlands	Outer Hebrides	Moray Firth	North Coast	Outer Hebrides	North East

Table HP. Site-date combinations (instances where a site was surveyed on a specific date, regardless of whether the species was observed) and the number of harbour porpoise positive records at each site. Sites highlighted in colour had a particularly strong influence on the analysis. These locations contributed disproportionately to the overall trends in the report, due to either high sighting frequency or consistent species presence.

Harbour Porpoise

Patterns and Trends

Regional Analysis (SMR)

At the regional level, the West Highlands and Outer Hebrides SMRs had the highest overall probability of harbour porpoise occurrence (figure HPd/e), although only the West Highlands, Moray Firth, and Forth and Tay showed significant temporal trends. In the North East, the results suggest there may be a temporal effect, although the evidence is not very strong. The West Highlands trend peaked around 2016 before declining, while the Moray Firth and Forth and Tay regions showed increasing trends over the study period.

Seasonal variation was again evident, with occurrence peaking in September–October. As might be expected, harbour porpoise occurrence increased with effort duration and was higher in better visibility and calmer sea states. No relationship was found with effort start time (Figure HPf). The regional model explained 30.4% of the deviance, with Year, SMR, and their interaction contributing approximately 19%. The adjusted R^2 was 0.277; the correlation between observed and predicted values was 0.717.

Sites in Orkney and Shetland haven't yet met the 6-year data requirement for the main analysis. Data from these regions was therefore reviewed separately and should be interpreted carefully, but early findings are promising (see Northern Isles preliminary analysis).

Key Findings

Harbour porpoise occurrence peaked seasonally in the autumn. West Highland SMR occurrence peaked before declining, Forth & Tay occurrence increased.

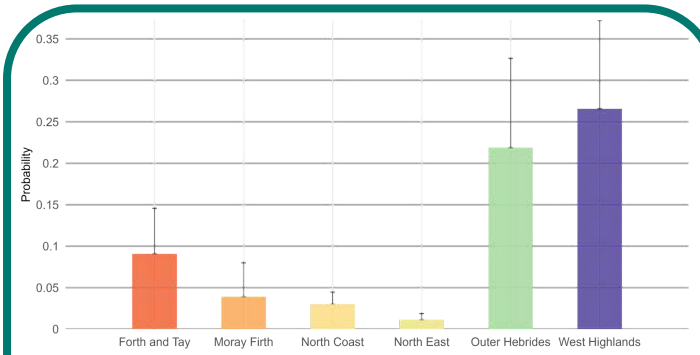

Figure HPd. Predicted harbour porpoise probability of occurrence with standard deviations for the six Scottish Marine Regions with sufficient effort.

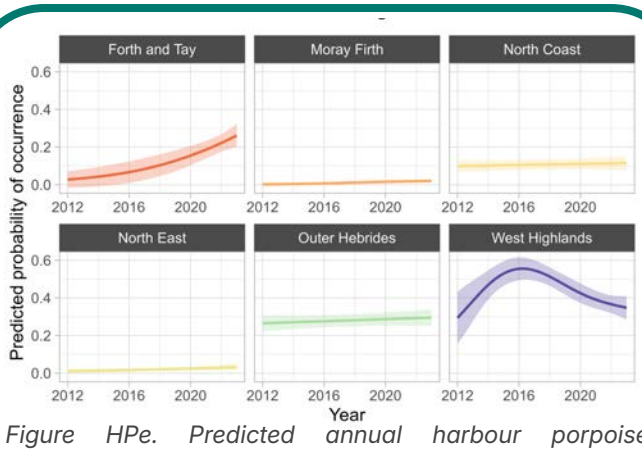

Figure HPe. Predicted annual harbour porpoise probability of occurrence for the six Scottish Marine Regions over the period 2012-2023.

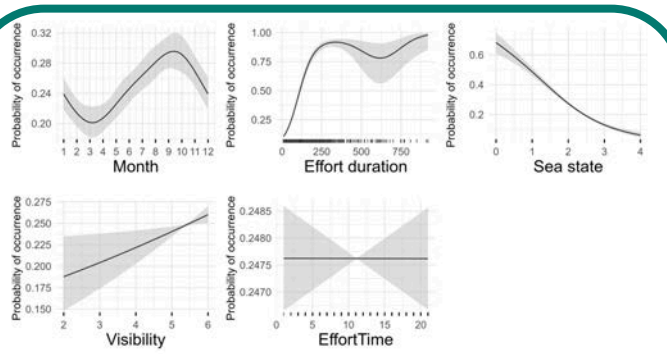

Figure HPf GAM smoother plots for harbour porpoise occurrence for the variables month, effort duration, sea state, visibility, and effort start time. For each smoother plot, the y-axis shows the probability of occurrence, and the X-axis indicates the values of the explanatory variables.

Discussion

Harbour porpoise occurrence across Shorewatch sites highlights the ecological importance of Scotland's west coast to this species, particularly the Outer Hebrides and West Highlands. Core Site and Regional Analyses consistently identified Rhue Lighthouse, Tiumpan Head, Kilt Rock, and Rodel as high occurrence locations, with seasonal peaks in July and October–November. While no significant long-term trend was found in the 14-site analysis, regional models showed increasing occurrence in the Moray Firth and Forth and Tay, and a decline in the West Highlands—consistent with earlier findings (Gutiérrez-Muñoz et al., 2021).

Key predictor variables included sea state and effort duration, with higher occurrence in calm conditions and deeper waters. These findings align with previous studies showing reduced detectability in sea states above Beaufort 1 (Booth et al., 2013). The Minches and Sea of the Hebrides, which include many of the high-occurrence sites, are recognised as a Special Area of Conservation and an Important Marine Mammal Area due to their role in feeding, breeding, and calving (Evans & James, 2019; IUCN-MMPATF, 2024). Together, these results reinforce the value of Shorewatch data for monitoring harbour porpoise distribution and support its continued use in conservation assessments.

Minke Whale

Patterns and Trends

This two-page summary presents results from recent analyses of Shorewatch data exploring trends in minke whale occurrence across Scotland. It includes findings from the Core Sites Analysis (2017-2023) and the Regional Scottish Marine Regions (SMR) Analysis (2012-2023), both supported by relevant figures and tables, and provides additional context from wider research. For full methodology and results, see Rodríguez-Mendoza et al. (2025).

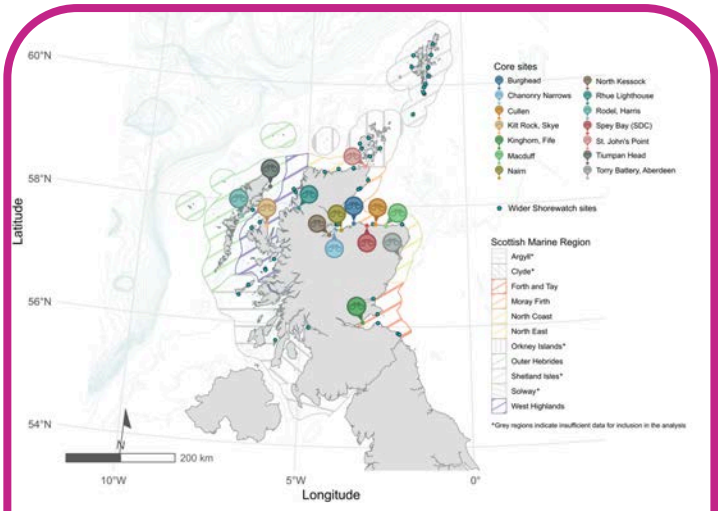

Figure SW Map. Showing the active observation sites of the Shorewatch Programme. Core sites and Scottish Marine Regions (SMRs) are highlighted.

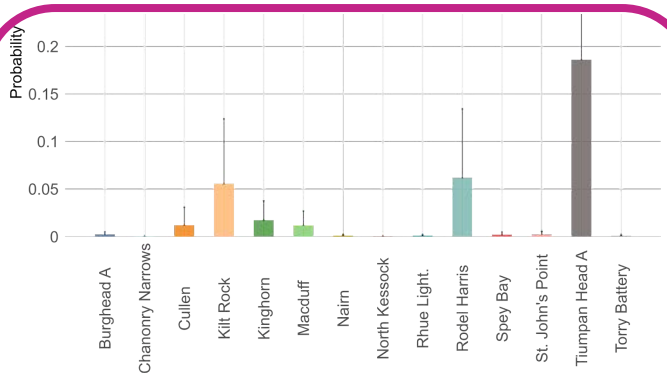

Figure MWa. Mean predicted minke whale probability of occurrence at each site. Error bars indicate one standard deviation of those predictions.

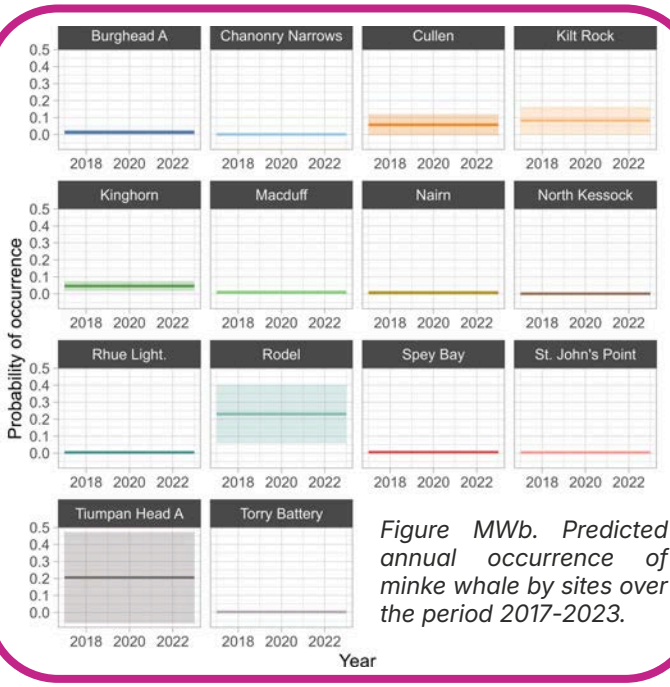

Figure MWb. Predicted annual occurrence of minke whale by sites over the period 2017-2023.

Core Sites Analysis

Minke whale sightings were most frequent at Tiumpan Head (Lewis), Kilt Rock (Skye), and Rodel (Harris), with Tiumpan Head contributing nearly half of all records (Table MW & Figures MWa/b). Seasonal patterns showed a peak in occurrence between June and August. Sightings were more likely during longer observation periods, in calmer sea states, and under better visibility conditions. Occurrence was slightly more probable in the evening (Figure MWc).

The model showed no significant change in occurrence over time; site was the most influential variable, explaining 21.05% of the deviance, followed by month and effort duration. The model had an adjusted R^2 of 0.297 and a correlation of 0.79 between observed and predicted values.

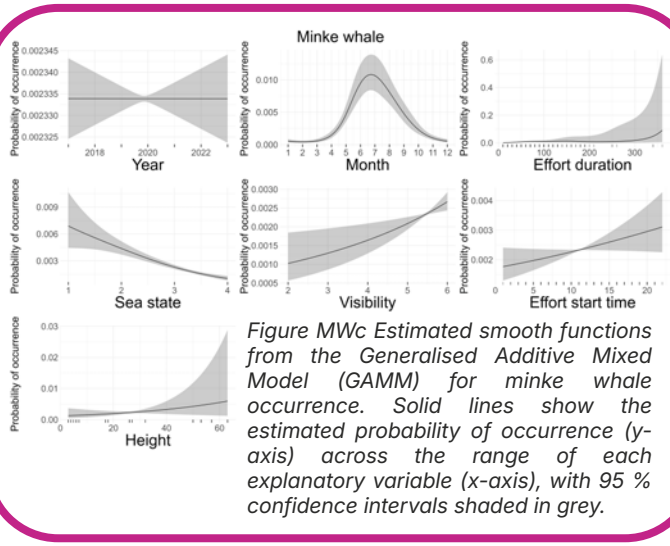

Figure MWc Estimated smooth functions from the Generalised Additive Mixed Model (GAMM) for minke whale occurrence. Solid lines show the estimated probability of occurrence (y-axis) across the range of each explanatory variable (x-axis), with 95 % confidence intervals shaded in grey.

Site name	Burghead	Chanonry Narrows	Cullen	Kilt Rock, Skye	Kinghorn, Fife	Macduff	Nairn	North Kessock	Rhue (Ullapool)	Rodel, Harris	Spey Bay (SDC)	St. John's Point	Tiumpan Head	Torry Battery (Aberdeen)
Site-date combinations	N = 927	N = 1434	N = 856	N = 905	N = 500	N = 2031	N = 651	N = 1558	N = 821	N = 430	N = 1484	N = 585	N = 800	N = 1214
Nr. of positive records	N = 3	N = 0	N = 12	N = 82	N = 11	N = 26	N = 1	N = 0	N = 1	N = 40	N = 4	N = 1	N = 182	N = 1
Scottish Marine Region (SMR)	Moray Firth	Moray Firth	Moray Firth	West Highlands	Forth and Tay	Moray Firth	Moray Firth	Moray Firth	West Highlands	Outer Hebrides	Moray Firth	North Coast	Outer Hebrides	North East

Table MW. Site-date combinations (instances where a site was surveyed on a specific date, regardless of whether the species was observed) and the number of minke whale positive records at each site. Sites highlighted in colour had a particularly strong influence on the analysis. These locations contributed disproportionately to the overall trends in the report, due to either high sighting frequency or consistent species presence.

Minke Whale
Patterns and Trends

Regional Analysis (SMR)

The Outer Hebrides SMR had the highest overall probability of minke whale occurrence. Significant trends were also found for the Moray Firth and North East regions (MWd). In the Outer Hebrides occurrence increased until 2017, followed by a slight decline. The Moray Firth and North East showed minimal increases over the entire study period (Figure MWe).

Seasonal variation was consistent with core site findings, with a summer peak (June–August) in minke whale sightings. Occurrence increased with effort duration (up to 300 mins / 30 watches per day), and was higher in better visibility and calmer sea states. No relationship was found with effort start time (Figure MWf). The regional model explained 40.4% of the deviance, with Year, region, and their interaction contributing approximately 26%. The adjusted R^2 was 0.315 and the correlation between observed and predicted values was 0.834.

Sites in Orkney and Shetland haven't yet met the 6-year data requirement for the main analysis. Data from these regions were therefore reviewed separately and should be interpreted carefully, but early findings are promising (see Northern Isles preliminary analysis).

Key Findings

Minke whale sightings peaked seasonally in June-July, with Tiumpan Head (Isle of Lewis) identified as an occurrence hotspot.

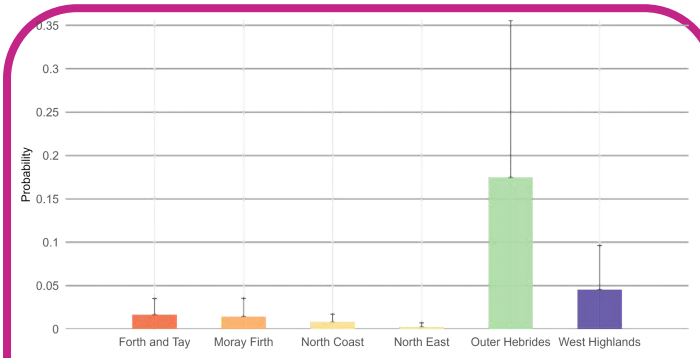

Figure MWd. Predicted minke whale probability of occurrence with standard deviations for the six Scottish Marine Regions with sufficient effort.

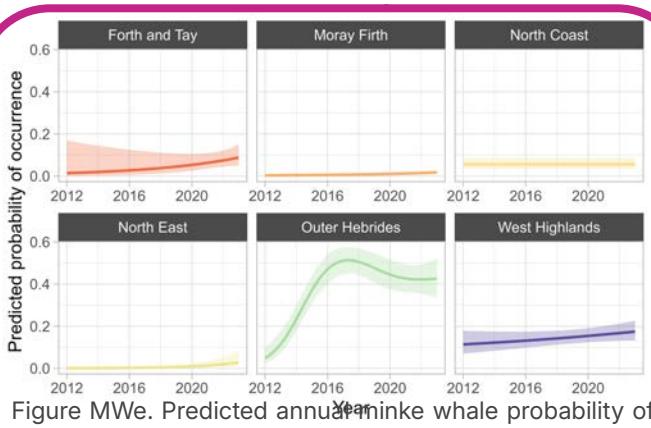

Figure MWe. Predicted annual minke whale probability of occurrence for the six Scottish Marine Regions over the period 2012-2023.

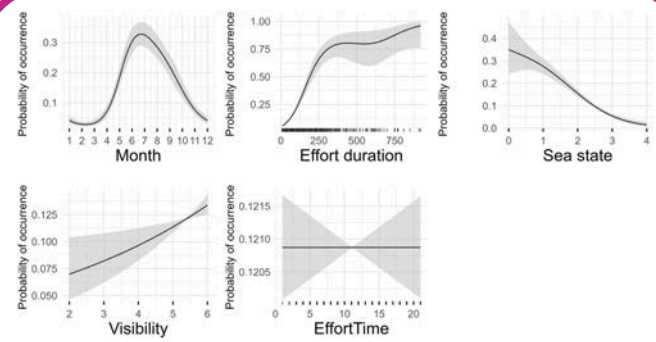

Figure MWf GAM smoother plots for minke whale occurrence for the variables month, effort duration, sea state, visibility, and effort start time. For each smoother plot, the y-axis shows the probability of occurrence, and the X-axis indicates the values of the explanatory variables.

Discussion

Shorewatch data confirm that minke whales are most frequently observed at sites in the Outer Hebrides and around Skye, particularly Tiumpan Head, Kilt Rock, and Rodel. These findings align with broader research identifying the Minches and Sea of the Hebrides as key seasonal habitats for the species, supporting feeding and breeding activity during the summer months (Evans & James, 2019; Hartny-Mills et al., 2024). The consistent seasonal peak in sightings between June and August across Shorewatch sites reflects these known patterns of prey availability and migratory behaviour.

In the Moray Firth, minke whales are known to use outer coastal waters as productive summer feeding grounds, particularly around the Southern Trench, which was designated a Marine Protected Area in 2020 due to its ecological significance (Robinson et al., 2009; NatureScot, 2020). Although Shorewatch data did not highlight specific high-occurrence sites within the Moray Firth, regional analyses suggest the area remains important for the species and underpin the need to increase effort from newer sites in Aberdeenshire.

Preliminary Shorewatch observations from the Northern Isles indicate higher occurrence in Shetland than Orkney, with late summer aggregations consistent with known patterns in northern Scottish waters (IUCN-MMPATF, 2024). These insights, while based on a shorter time series, contribute to a growing understanding of minke whale distribution across Scotland. Taken together, Shorewatch data provide valuable context for interpreting minke whale habitat use and seasonality, complementing wider research and supporting conservation planning under national and regional marine frameworks.

Risso's Dolphin

Patterns and Trends

This two-page summary presents results from recent analyses of Shorewatch data exploring trends in bottlenose dolphin occurrence across Scotland. It includes findings from the Core Sites Analysis (2017-2023) and the Regional Scottish Marine Regions (SMR) Analysis (2012-2023), both supported by relevant figures and tables, and provides additional context from wider research. For full methodology and results, see Rodríguez-Mendoza et al. (2025).

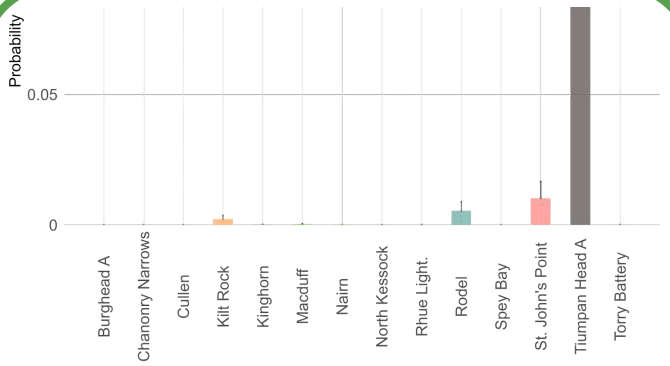

Figure RDa. Mean predicted Risso's dolphin probability of occurrence at each site. Error bars indicate one standard deviation of those predictions.

Core Sites Analysis

Risso's dolphin sightings were highest at Tiumpan Head, which accounted for the vast majority of positive records. Seasonal patterns showed a peak in August and occurrence was slightly more probable in the morning. The model indicated a decline in occurrence over time, although the year effect was not statistically significant. Site was the most important explanatory variable, accounting for 41% of the deviance, followed by effort duration and month. (Figures RD a/b/c, Table RD)The model had an adjusted R^2 of 0.191 and a correlation of 0.681 between observed and predicted values.

It is important to note that some sites with a relatively high number of Risso's dolphin sightings were not included in the core site analysis due to not meeting the minimum six-year effort requirement. For example, Latheronwheel, located near the boundary of the Moray Firth and North Coast regions, was excluded from the core analysis but did contribute to regional trends. This highlights the importance of considering both long-term and emerging observation sites when interpreting species distribution.

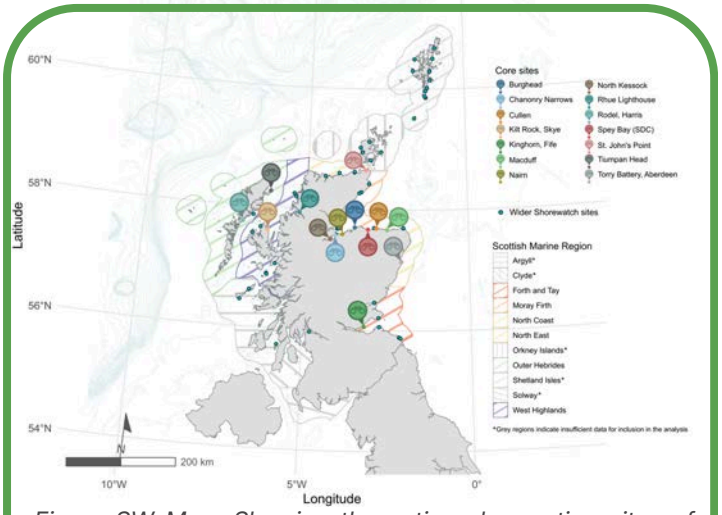

Figure SW Map. Showing the active observation sites of the Shorewatch Programme. Core sites and Scottish Marine Regions (SMRs) are highlighted.

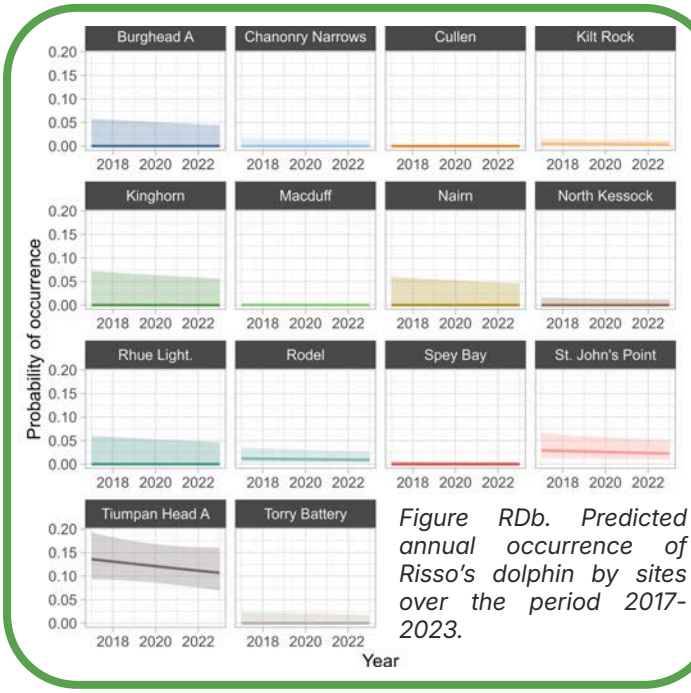

Figure RDb. Predicted annual occurrence of Risso's dolphin by sites over the period 2017-2023.

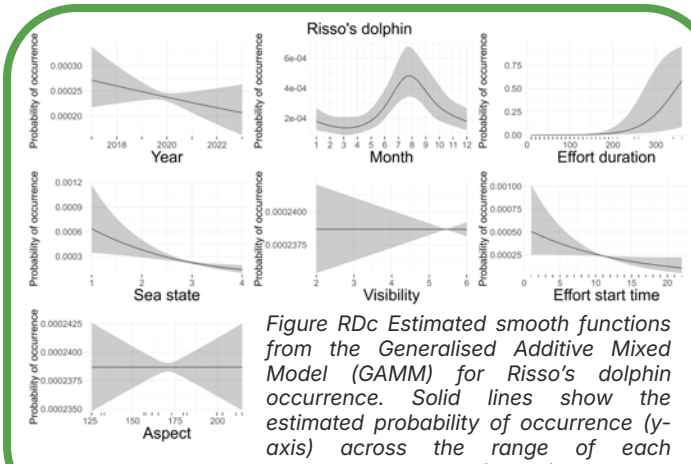

Figure RDc Estimated smooth functions from the Generalised Additive Mixed Model (GAMM) for Risso's dolphin occurrence. Solid lines show the estimated probability of occurrence (y-axis) across the range of each explanatory variable (x-axis), with 95 % confidence intervals shaded in grey.

Site name	Burghead	Chanonry Narrows	Cullen	Kilt Rock, Skye	Kinghorn, Fife	Macduff	Nairn	North Kessock	Rhue (Ullapool)	Rodel, Harris	Spey Bay (SDC)	St. John's Point	Tiumpan Head	Torry Battery (Aberdeen)
Site-date combinations	N = 927	N = 1434	N = 856	N = 905	N = 500	N = 2031	N = 651	N = 1558	N = 821	N = 430	N = 1484	N = 585	N = 800	N = 1214
Nr. of positive records	N = 0	N = 0	N = 0	N = 3	N = 0	N = 1	N = 0	N = 0	N = 0	N = 4	N = 0	N = 8	N = 89	N = 0
Scottish Marine Region (SMR)	Moray Firth	Moray Firth	Moray Firth	West Highlands	Forth and Tay	Moray Firth	Moray Firth	Moray Firth	West Highlands	Outer Hebrides	Moray Firth	North Coast	Outer Hebrides	North East

Table RD. Site-date combinations (instances where a site was surveyed on a specific date, regardless of whether the species was observed) and the number of Risso's dolphin positive records at each site. Sites highlighted in colour had a particularly strong influence on the analysis. These locations contributed disproportionately to the overall trends in the report, due to either high sighting frequency or consistent species presence.

WDC WHALE AND DOLPHIN CONSERVATION

Risso's Dolphin

Patterns and Trends

Regional Analysis (SMR)

Regionally, significant trends were found for the Moray Firth, the North Coast, the West Highlands, and the Outer Hebrides. , Predicted probability of occurrence was higher in the Outer Hebrides. In this region, occurrence increased until 2017, followed by a slight decline. The North Coast and Moray Firth showed upward trends, while the West Highlands showed a declining trend (Figures RDd/RDe).

Seasonal variation showed a peak in September, and occurrence increased with effort duration, better visibility, and calmer sea states. Occurrence was more likely in the morning, decreasing over the course of the day (Figure RDf).

The regional model explained 40.4% of the deviance, with Year, SMR and their interaction contributing over 32%. The adjusted R^2 was 0.248, and the correlation between observed and predicted values was 0.771.

Sites in Orkney and Shetland haven't yet met the 6-year data requirement for the main analysis. Data were therefore reviewed separately and should be interpreted carefully, but early findings are promising (N. Isles preliminary analysis).

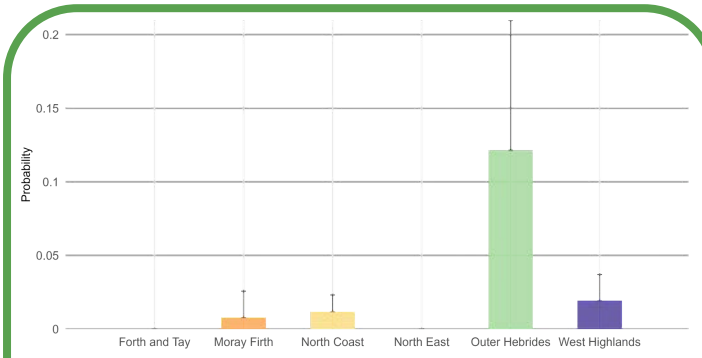

Figure RDd. Predicted Risso's dolphin probability of occurrence with standard deviations for the six Scottish Marine Regions with sufficient effort.

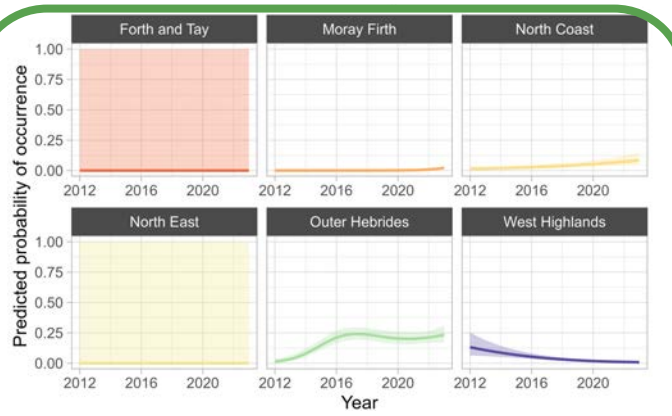

Figure RDe. Predicted annual Risso's dolphin probability of occurrence for the six Scottish Marine Regions over the period 2012-2023.

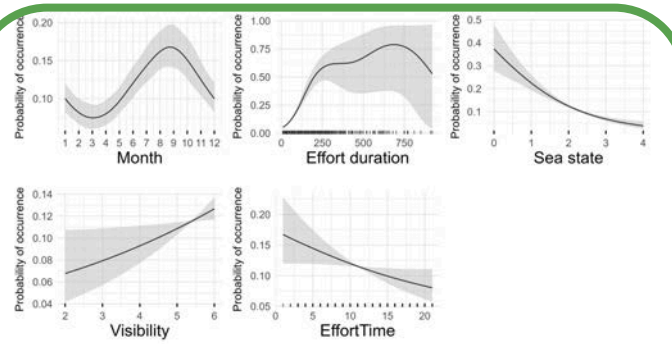

Figure RDf GAM smoother plots for Risso's dolphin occurrence for the variables month, effort duration, sea state, visibility, and effort start time. For each smoother plot, the y-axis shows the probability of occurrence; the X-axis indicates the values of the explanatory variables.

Key Findings

Risso's dolphin occurrence showed a seasonal peak in late summer and a hotspot was observed in Tiumpan Head. Keep an eye on Latheronwheel!

Discussion

Shorewatch data highlight Tiumpan Head as a key site for Risso's dolphin sightings, with wider records coming in from Core Sites such as Rodel, Kilt Rock, and St. John's Point. While some Shorewatch sites with notable sightings—such as Latheronwheel, Caithness—were excluded from core analyses due to limited long-term data, their contribution to regional patterns underscores the value of including emerging locations in future assessments.

These patterns reflect the species' known preference for deeper, offshore waters, though individuals are regularly observed around the Isle of Lewis during summer months. Seasonal peaks in August and September align with wider research identifying the Minches and Sea of the Hebrides as important breeding and calving grounds (Evans & James, 2019; IUCN-MMPATF, 2024).

The designation of the North-east Lewis NCMPA in 2020 reflects the ecological significance of this area for Risso's dolphins, particularly for mothers with calves and juvenile groups (Weir et al., 2019). Although recent survey data from the Hebridean Whale and Dolphin Trust (HWDT) suggest low sighting rates in this region, this was likely influenced by limited survey effort and challenging conditions (Hartny-Mills et al., 2024), reinforcing the importance of Shorewatch as a complementary monitoring tool, capable of capturing fine-scale patterns in Risso's dolphin occurrence and supporting broader conservation efforts across Scotland's west coast.

WDC WHALE AND DOLPHIN CONSERVATION

Common Dolphin

Patterns and Trends

This 2-page summary presents results from recent analyses of Shorewatch data exploring trends in common dolphin occurrence across Scotland. It includes findings from the Core Sites Analysis (2017-2023) and the Regional Scottish Marine Regions (SMR) Analysis (2012-2023), both supported by relevant figures and tables, and provides additional context from wider research. For full methodology and results, see Rodríguez-Mendoza et al. (2025).

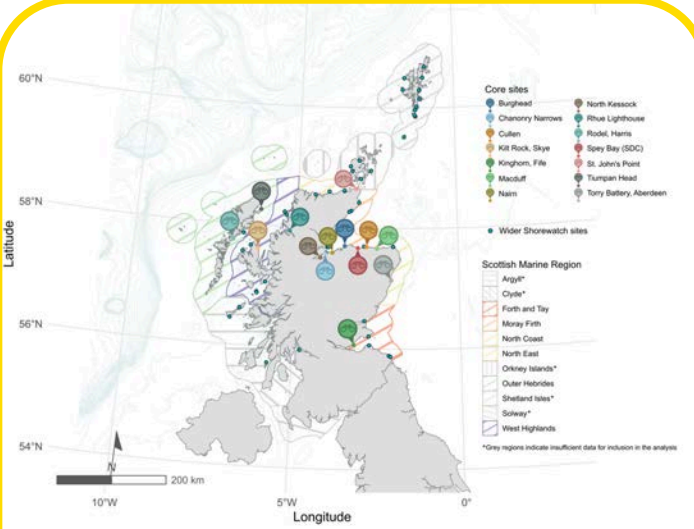

Figure SW Map. Showing the active observation sites of the Shorewatch Programme. Core sites and Scottish Marine Regions (SMRs) are highlighted.

Core Sites Analysis

Common dolphin sightings were most frequent at Kilt Rock (Skye), Rhue Lighthouse (Ullapool), and Tiumpan Head, with these three sites contributing the vast majority of positive records. Seasonal patterns showed a peak in August, and occurrence increased significantly after 200 minutes of observation effort. Sightings were more likely in calmer sea states, with a slight increase under better visibility and during the evening (Table CD, Figures CDa/CDb/CDc).

The model showed a weak upward trend in common dolphin occurrence over time across all sites, with site being the most influential variable, explaining 31.4% of the deviance, followed by month, effort duration, and sea state. The model had an adjusted R^2 of 0.199 and a correlation of 0.654 between observed and predicted values.

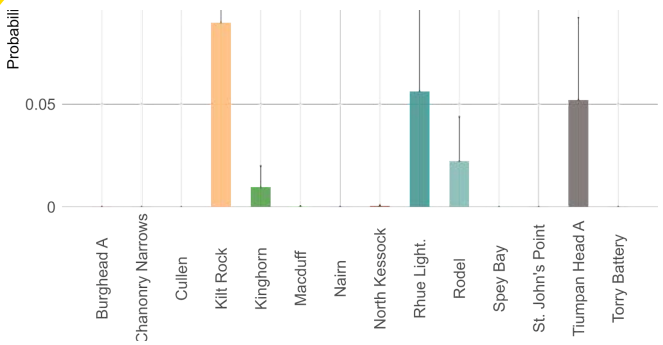

Figure CDa. Mean predicted common dolphin probability of occurrence at each site. Error bars indicate one standard deviation of those predictions.

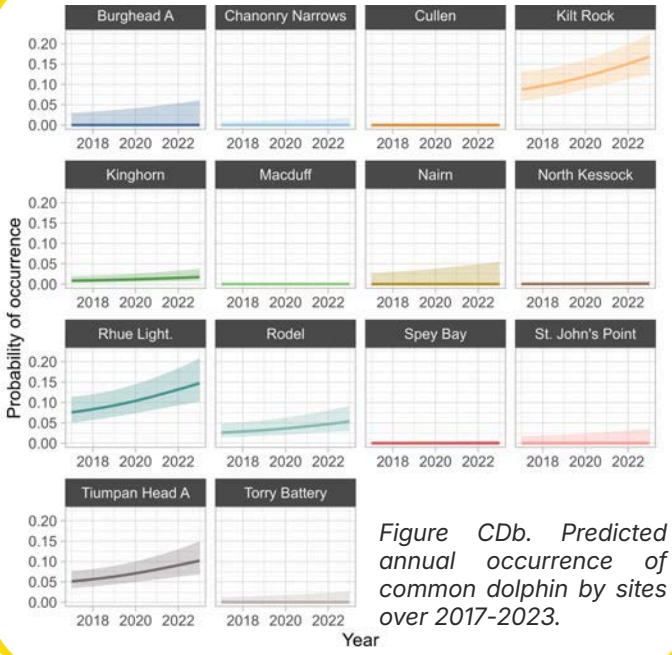

Figure CDb. Predicted annual occurrence of common dolphin by sites over 2017-2023.

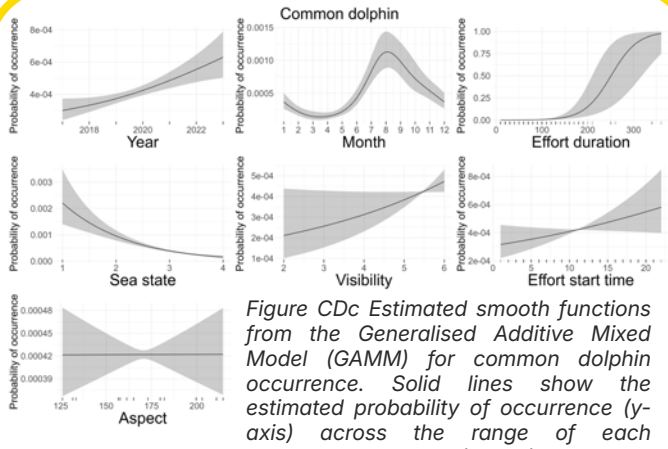

Figure CDc Estimated smooth functions from the Generalised Additive Mixed Model (GAMM) for common dolphin occurrence. Solid lines show the estimated probability of occurrence (y-axis) across the range of each explanatory variable (x-axis), with 95 % confidence intervals shaded in grey.

Site name	Burghead	Chanonry Narrows	Cullen	Kilt Rock, Skye	Kinghorn, Fife	Macduff	Nairn	North Kessock	Rhue (Ullapool)	Rodel, Harris	Spey Bay (SDC)	St. John's Point	Tiumpan Head	Torry Battery (Aberdeen)
Site-date combinations	N = 927	N = 1434	N = 856	N = 905	N = 500	N = 2031	N = 651	N = 1558	N = 821	N = 430	N = 1484	N = 585	N = 800	N = 1214
Nr. of positive records	N = 0	N = 0	N = 0	N = 122	N = 8	N = 1	N = 0	N = 1	N = 52	N = 18	N = 0	N = 0	N = 52	N = 0
Scottish Marine Region (SMR)	Moray Firth	Moray Firth	Moray Firth	West Highlands	Forth and Tay	Moray Firth	Moray Firth	Moray Firth	West Highlands	Outer Hebrides	Moray Firth	North Coast	Outer Hebrides	North East

Table MW. Site-date combinations (instances where a site was surveyed on a specific date, regardless of whether the species was observed) and the number of minke whale positive records at each site. Sites highlighted in colour had a particularly strong influence on the analysis. These locations contributed disproportionately to the overall trends in the report, due to either high sighting frequency or consistent species presence.

WDC WHALE AND DOLPHIN CONSERVATION

Common Dolphin
Patterns and Trends

Regional Analysis (SMR)

At an SMR scale, the Outer Hebrides and West Highlands had the highest overall probability of common dolphin occurrence, although values remained low overall. Significant upward trends were observed in these regions, as well as in Forth and Tay, where the increase was evident only after 2018 due to an increase in Shorewatch effort in the region from this year (Figures CDd/CDe).

Seasonal variation showed a peak in August, and occurrence increased with effort duration up to ~250 minutes, then declined. Sightings were more likely in better visibility and calmer sea states, while effort start time had no significant effect (Figure CDf).

The regional model explained 44.3% of the deviance, with Year and SMR interaction contributing nearly 30%. The adjusted R^2 was 0.295, and the correlation between observed and predicted values was 0.781.

Sites in Orkney and Shetland haven't yet met the 6-year data requirement for the main analysis. Data from these regions were therefore reviewed separately and should be interpreted carefully, but early findings are promising (see Northern Isles preliminary analysis).

Key Findings

Common dolphin occurrence was highest in the Outer Hebrides and West Highlands, and showed a seasonal peak in summer.

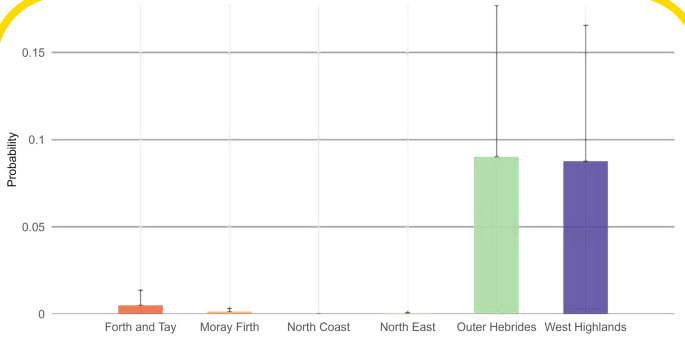

Figure CDd. Predicted common dolphin probability of occurrence with standard deviations for the six Scottish Marine Regions with sufficient effort.

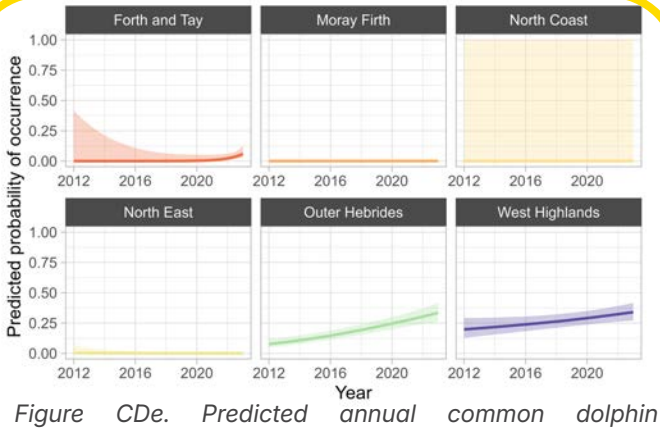

Figure CDe. Predicted annual common dolphin probability of occurrence for the six Scottish Marine Regions over the period 2012-2023.

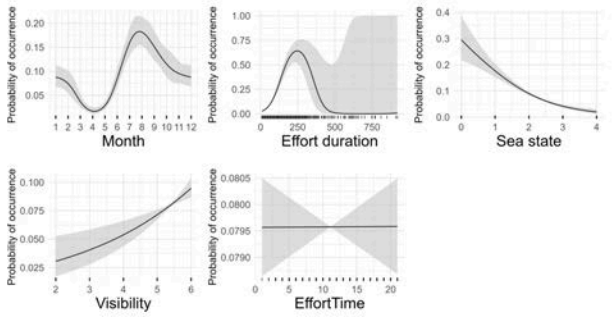

Figure CDf GAM smoother plots for common dolphin occurrence for the variables month, effort duration, sea state, visibility, and effort start time. For each smoother plot, the y-axis shows the probability of occurrence, and the X-axis indicates the values of the explanatory variables.

Discussion

Shorewatch data identified Kilt Rock, Rhue Lighthouse, and Tiumpan Head as key sites for common dolphin occurrence, with seasonal peaks in August and increased sightings during longer observation periods and favourable sea conditions. These patterns are consistent with broader research showing high summer sighting rates in the Little Minch and Sea of the Hebrides, and more localised winter distributions in areas such as the Sound of Sleat and Firth of Lorn (Hartny-Mills et al., 2024; Evans & James, 2019).

Common dolphins in western Scotland are typically found in deeper waters (70–240 m) and further offshore, with habitat preferences confirmed by both Shorewatch and earlier studies (Weir et al., 2009). The regional analyses also reflect a wider northward expansion of the species' range, as documented in recent literature (MacLeod et al., 2005; Evans & Waggitt, 2020), with increasing sightings in the northern Minch and Forth and Tay regions.

These findings highlight the value of Shorewatch data in capturing seasonal and spatial patterns of common dolphin occurrence and contribute to understanding how distribution may be shifting in response to environmental changes.

Humpback Whale
Patterns and Trends

Regional Analysis (SMR)

Occurrences of humpback whale were relatively infrequent across the dataset and thus did not meet the inclusion criteria for the core sites analysis. However, the broader spatial assessment across Scottish Marine Regions (SMRs) enabled the incorporation of data from additional sites and included enough sightings of humpback whales to explore emerging trends at the regional scale (Figure HWa).

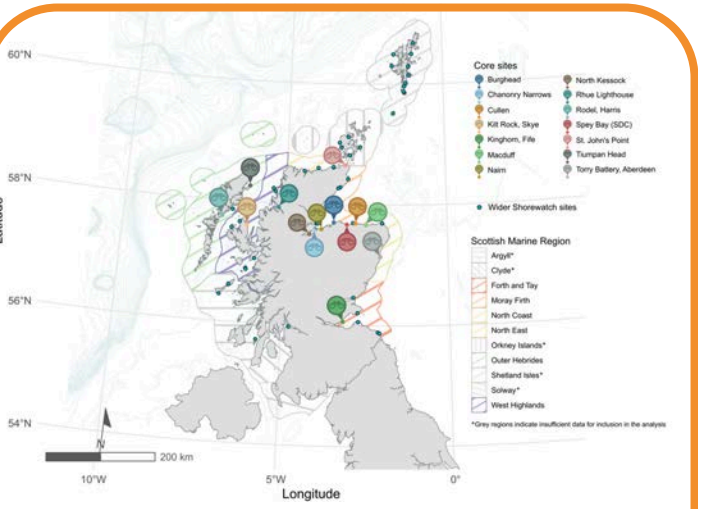

Figure SW Map. Showing the active observation sites of the Shorewatch Programme. Core sites and Scottish Marine Regions (SMRs) are highlighted.

Although humpback whale sightings were relatively rare, the regional analysis revealed some clear patterns. The Outer Hebrides had the highest probability of occurrence, with a noticeable peak around 2016–2017. Smaller upward trends were also seen in the West Highlands and Moray Firth, though the trends were only marginally significant (Figure HWb). While the Forth and Tay region was included in the analysis and appears to have higher rates of occurrence, no significant trend was found there, and predicted occurrence remained low throughout the study period – perhaps due to the very limited amount of data available prior to 2018 in this region.

Sightings were higher during greater observation effort per day, and more likely in calm sea conditions, with good visibility, and early in the morning. A seasonal peak in December was also observed (Figure HWc).

While overall occurrence was low (Outer Hebrides mean probability of occurrence = 0.049), the model still captured meaningful variation across regions

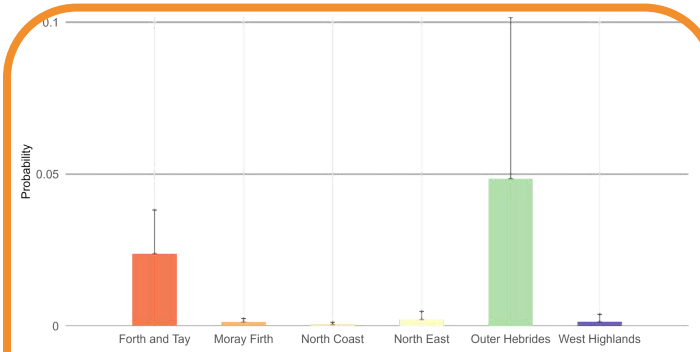

Figure HWa. Predicted humpback whale probability of occurrence with standard deviations for the six Scottish Marine Regions with sufficient effort.

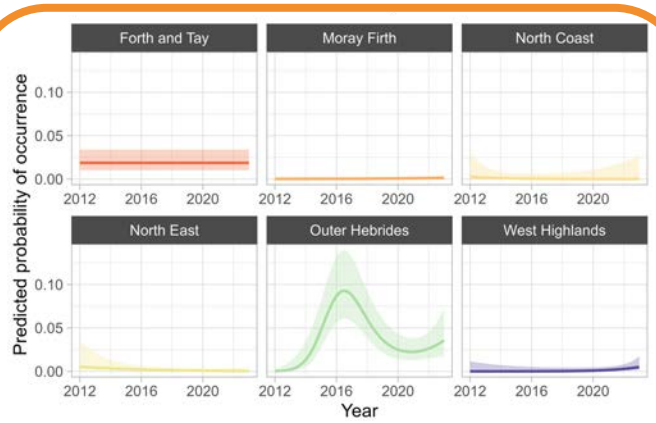

Figure HWb. Predicted annual humpback whale probability of occurrence for the six Scottish Marine Regions over the period 2012-2023.

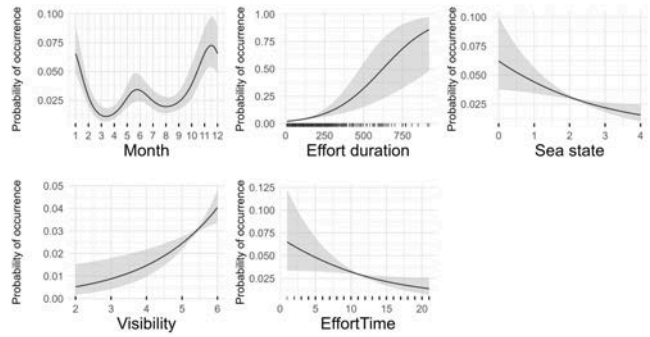

Figure HWc GAM smoother plots for humpback whale occurrence for the variables month, effort duration, sea state, visibility, and effort start time. For each smoother plot, the y-axis shows the probability of occurrence; the X-axis indicates the values of the explanatory variables.

and seasons. Year, SMR, and their interaction explained 28.1% of the deviance, followed by month and effort duration. The model had an adjusted R^2 of 0.135 and a correlation of 0.574 between observed and predicted values.

Sites in Orkney and Shetland haven't yet met the 6-year data requirement for the main analysis. Data from these regions were therefore reviewed separately and should be interpreted carefully, but early findings are promising (see Northern Isles preliminary analysis).

Humpback Whale

Patterns and Trends

Key Findings

Humpback whale occurrence showed a seasonal peak in late autumn and winter.

Discussion

Humpback whale sightings were relatively infrequent in Shorewatch data, but regional analyses suggested emerging patterns, particularly in the Outer Hebrides, and potentially in the West Highlands, and Moray Firth. Sightings were most likely during longer watches in calm conditions, with a seasonal peak in December. These findings align with broader observations of increasing humpback whale presence in Scottish waters, especially around Skye and the Moray Firth, where individuals have been recorded between June and January (Marwood et al., 2022).

Recent studies suggest that the Moray Firth and Firth of Forth may serve as migratory stopovers or seasonal feeding grounds, particularly for juveniles or individuals undertaking incomplete migrations (O'Neil et al., 2019). The winter presence of humpbacks in these areas may reflect changing prey availability or a return to historically used habitats, as documented in whaling records from the early 20th century (Ryan et al., 2022).

Notably, humpback whale visits to Scottish waters are increasing at a rate that exceeds what could be attributed solely to population growth, suggesting a shift in distribution. This trend coincides with a rise in entanglement incidents in static fishing gear, highlighting the need for continued monitoring and mitigation efforts (Leaper et al., 2022).

With its year-round and widespread effort, Shorewatch data provide valuable local and wide-scale insights into humpback whale occurrence and seasonality, complementing wider research and supporting conservation planning in response to ecological change.

WDC WHALE AND DOLPHIN CONSERVATION

White-beaked Dolphin

Patterns and Trends

Key Findings

White-beaked dolphin occurrence peaked in June-July, with notable seasonal fluctuations.

Regional Analysis (SMR)

Occurrences of white-beaked dolphin were relatively infrequent across the dataset and thus did not meet the inclusion criteria for the core sites analysis. However, the broader spatial assessment across Scottish Marine Regions (SMRs) enabled the incorporation of data from additional sites and included enough sightings of white-beaked dolphins to explore emerging trends at the regional scale.

The Outer Hebrides showed the highest probability of white-beaked dolphin occurrence, with a clear peak in 2017–2018, followed by a decline in subsequent years. No significant trends were found in other regions (Figure WBDa/WBDb).

Sightings were more likely during longer observation efforts, with a seasonal peak in June and a smaller peak in December–January. White-beaked dolphin occurrence decreased with worsening sea state and increased slightly with better visibility, though this latter trend was not statistically significant. Effort start time had no notable effect (Figure WBDc).

While overall occurrence was low (Outer Hebrides mean = 0.053), the model captured meaningful variation. Year; SMR and their interaction explained 38.6% of the deviance, followed by month, sea state, and effort duration. The model had an adjusted R^2 of 0.237 and a correlation of 0.806 between observed and predicted values.

Figure WBDa. Predicted white-beaked dolphin probability of occurrence with standard deviations for the six Scottish Marine Regions with sufficient effort.

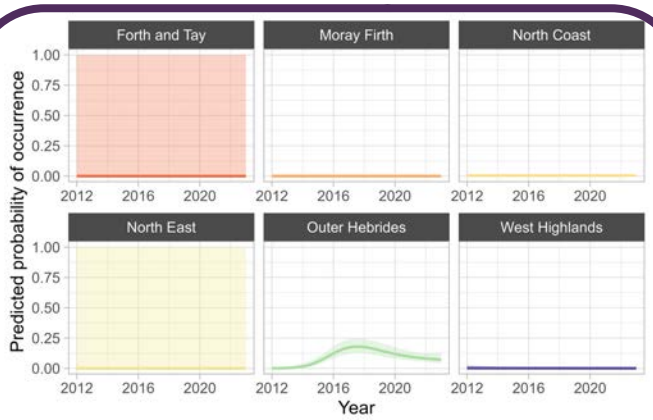

Figure WBDb. Predicted annual white-beaked dolphin probability of occurrence for the six Scottish Marine Regions over the period 2012-2023.

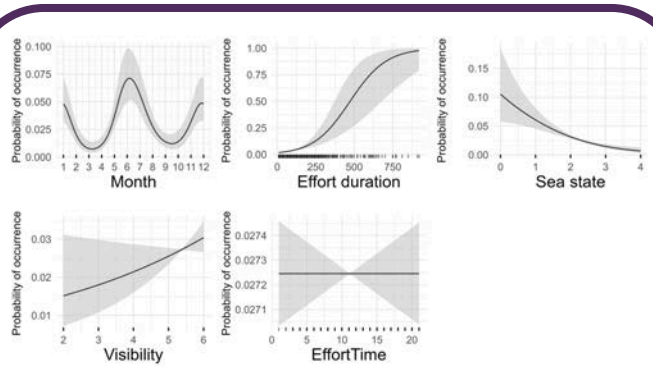

Figure WBDc GAM smoother plots for white-beaked dolphin occurrence for the variables month, effort duration, sea state, visibility, and effort start time. For each smoother plot, the y-axis shows the probability of occurrence, and the X-axis indicates the values of the explanatory variables.

Discussion

White-beaked dolphin sightings were relatively infrequent in Shorewatch data, but regional analysis revealed a clear peak in the Outer Hebrides during 2017–2018, with seasonal highs in June and a smaller peak in winter. These patterns align with broader observations of the species' distribution in deeper offshore waters, particularly the north Minch and west of Harris (Weir et al., 2009; Hartny-Mills et al., 2024).

Although included in all six SMRs, no significant trends were found outside the Outer Hebrides. Sightings were more likely during longer watches and in calm sea conditions, consistent with known detection challenges for this species. SCANS-IV survey data confirm that northwest Scotland remains a key area for white-beaked dolphins, with high densities recorded near the Outer Hebrides and Shetland Islands (Gilles et al., 2023).

Despite being a Priority Marine Feature (PMF), white-beaked dolphins are currently the only PMF cetacean species in Scotland without a designated Marine Protected Area. Shorewatch data provide valuable local-scale insights into their seasonal presence and support the case for enhanced protection and continued monitoring.

Northern Isles
Preliminary Analysis

Introduction

The Northern Isles (Orkney and Shetland) were analysed separately due to the shorter time series available (2021–2023), which does not yet meet the six-year minimum required for inclusion in the core Shorewatch analysis. Despite this limitation, early findings from these regions are promising in their potential to offer valuable insight into cetacean occurrence patterns for both harbour porpoise and minke whale. Analysis for other species will be conducted once there are sufficient data.

Binomial GAM models were developed for each species to explore patterns in occurrence. These results should be interpreted with caution due to the limited data duration, but they offer an initial insight into the potential trends at Northern Isles Shorewatch sites and highlight the strength of Shorewatch in capturing early signals of change in cetacean presence. They also underscore the importance of supporting volunteers toward sustained and spatially balanced effort to enhance future monitoring and research. For full methodology and results, see Rodríguez-Mendoza et al. (2025).

Key Findings

Shorewatch data have highlighted certain bays around Shetland as areas where harbour porpoise aggregate in high numbers, with occurrence peaking seasonally in autumn and winter.

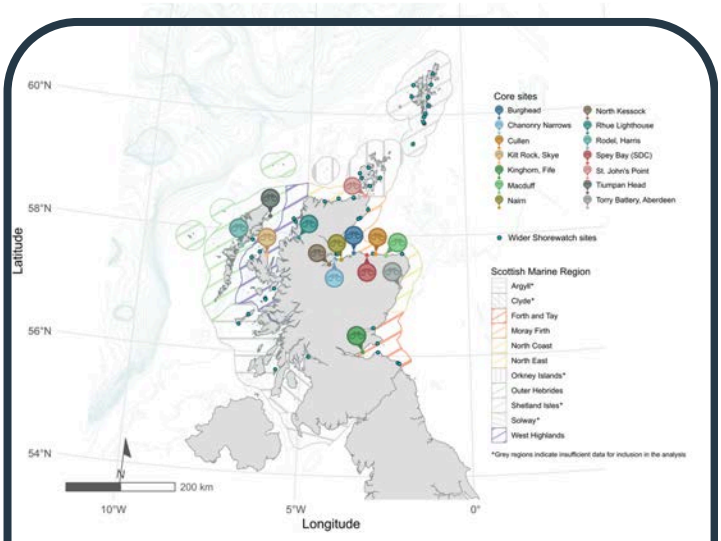

Figure SW Map. Showing the active observation sites of the Shorewatch Programme. Core sites and Scottish Marine Regions (SMRs) are highlighted.

Results and Trends

Harbour Porpoise

The best-fitting model for harbour porpoise included the effects of Scottish Marine Region (SMR), effort duration, sea state, month, and year. The probability of occurrence showed a downward trend over time, with seasonal peaks in September and February. Occurrence increased slightly with longer effort durations and decreased with worsening sea state.

Model predictions indicated a marked regional difference, with higher probability of occurrence in Shetland (Mean = 0.292, SD = 0.126) compared to Orkney (Mean = 0.018, SD = 0.009). A weak upward trend was observed in Shetland across the three-year period.

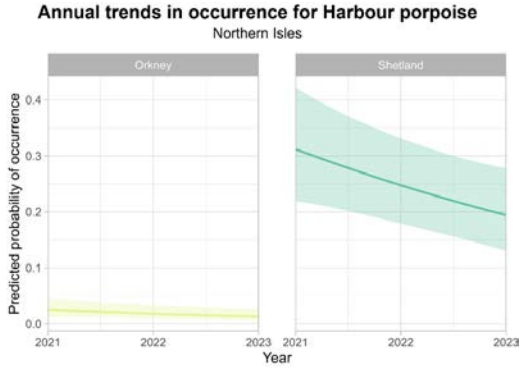

Figure NIa. Predicted annual harbour porpoise probability of occurrence for the Northern Isles over the period 2021-2023.

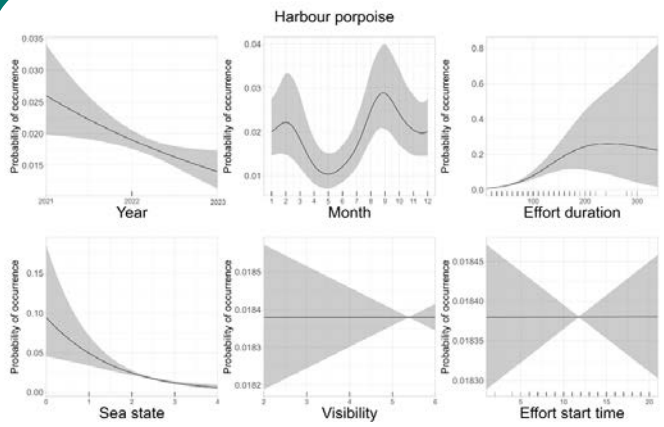

Figure NIb. Harbour porpoise occurrence in the Northern Isles: GAM plot. For each smoother plot, the y-axis shows the probability of occurrence and the X-axis indicates the values of the explanatory variables. The 95% confidence bands are shown in light blue.

WDC WHALE AND DOLPHIN CONSERVATION

Northern Isles
Preliminary Analysis

Results and Trends

Minke whale

The best-fitting model for minke whale included month, SMR, effort duration, sea state, effort start time, year, and visibility. The probability of occurrence showed a seasonal peak in September, with a weak upward trend over time, although the year effect was not statistically significant. Occurrence was higher in the morning and decreased with worsening sea state. Visibility had no significant effect.

Model predictions showed low overall probabilities, but again a regional difference, with higher occurrence in Shetland (Mean = 0.057, SD = 0.094) than in Orkney (Mean = 0.004, SD = 0.007). A weak upward trend was observed in Shetland across the three-year period.

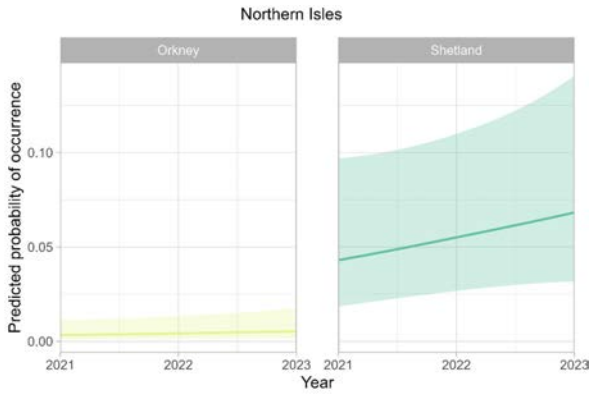

Figure NIc. Year to year variation in predicted minke whale probability of occurrence with standard deviations, yearly for the two Scottish Marine Regions in the Northern Isles over the period 2012-2023.

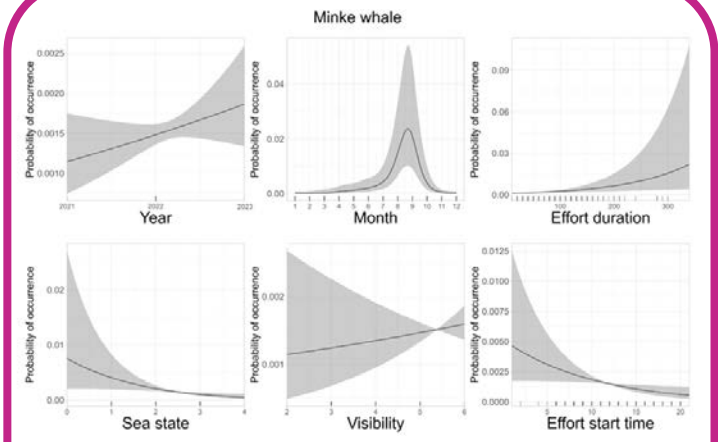

Figure NId. Minke whale occurrence in the Northern Isles: GAM plot. For each smoother plot, the y-axis shows the probability of occurrence and the X-axis indicates the values of the explanatory variables. The 95% confidence bands are shown in light blue.

Discussion

Although the time series is short, the Northern Isles data suggest notable trends for both harbour porpoise and minke whale. The data highlight seasonal aggregations of harbour porpoise, particularly in autumn and winter. Observers have reported large groups in specific bays, especially in Shetland, where individual counts can be high even if the number of positive efforts remains stable. These aggregations may reflect important seasonal foraging behaviour or habitat use, and further investigation is warranted. Preliminary results suggest that minke whales are more frequently observed in late summer, showing a clear seasonal peak in September and consistent with known aggregation behaviour in the region. These findings align with broader observations of minke whale presence in the Northern Isles during late summer and autumn (IUCN-MMPATF, 2024).

The regional disparity in occurrence, with Shetland showing significantly higher probabilities than Orkney for both species, is likely influenced by imbalances in site-specific effort. Orkney data is largely drawn from a single site, while Shetland benefits from multiple active sites—several of which are on track to meet the minimum data requirement for core site status, with additional sites contributing regular effort.

All trends discussed in this report relate specifically to coastal sightings and may not represent cetacean activity in offshore areas of each Scottish Marine Region. Low overall probability values (particularly for minke whales) and limited data duration mean that trends should be interpreted cautiously. Nonetheless, these early findings provide a useful foundation for future monitoring and reinforce the value of Shorewatch in the Northern Isles. They highlight the importance of continued data collection in both regions, supporting volunteers to ensure sustained and evenly distributed effort across sites.

Shorewatch data collected across Shetland, Orkney, and more widely was instrumental in the designation of Important Marine Mammal Areas (IMMAs) in 2024. An EU Mission Funded Blue Connect Project is now running through 2027 to bolster further data collection within the Shetland IMMA, providing Shorewatch with a direct opportunity to co-develop marine conservation in the region. Continued collaboration with researchers and other regional initiatives will be essential to provide ecological context and strengthen future analyses.

These regions do not meet the six-year minimum effort, but early findings from the Northern Isles are promising and support continued Shorewatch.

4. Discussion

This analysis of Shorewatch data collected between 2012 and 2023 has showcased a dramatic increase in observation effort, particularly during the winter months. Since the previous analysis by Gutiérrez-Muñoz et al. (2021) of data collected up to the end of 2018, the Shorewatch programme has substantially expanded its temporal coverage. While most efforts between 2018 and 2023 still took place between April and October, an approximate doubling of winter observation effort occurred. This has contributed to improved ability to define overall trends in abundance and strengthened the robustness of seasonal trends. The expanded temporal effort, especially in previously underrepresented winter months, has provided new insights into cetacean distribution patterns. Notably, it identified a second harbour porpoise peak in November, in addition to the previously documented summer peak in July. This highlights the Shorewatch programme's ability to adapt in order to address spatial and temporal data gaps, including by increasing observation efforts in underrepresented periods and expanding to new sites.

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The inclusion of data from 8 additional sites in the Core Sites Analysis, (expanded from 6 to 14 sites), has allowed for a more comprehensive regional perspective. The broadened geographic scope now includes sites from regions such as the Outer Hebrides and West Highlands, enhancing the representation of cetacean presence in these areas. This broader scope revealed that, for species such as the harbour porpoise, areas such as Kilt Rock (Skye), Rhue Lighthouse (Ullapool), Kinghorn (Fife), and St. John's Point (Caithness) exhibit similarly high probabilities of occurrence, comparable with previously recognised key sites (Tiumpan Head). This expansion allows for improved identification of important areas for species occurrence, providing a more detailed understanding of regional variations along the Scottish coastline.

Nonetheless, uneven distribution of Shorewatch monitoring effort spatially (between sites) and temporally (between years and seasons) can potentially bias the observed trends in occurrence. An ongoing challenge is standardising effort between sites and seasons, through continuing to increase the number of winter watches that are conducted.

The new Regional Analysis allowed, for the first time, the incorporation of survey data from sites that were not achieving the minimum effort requirements for inclusion in the core site analyses. This helps to address gaps in data due to the exclusion of sites that do not meet the thresholds for being analysed separately but still provide valuable information. By combining data from additional sites to assess trends at a regional level, this analysis increases spatial coverage and enhances the overall understanding of cetacean distribution and abundance across broader areas.

This greater spatial coverage offers a more comprehensive perspective on species occurrence, which may be critical for informing conservation and management actions. The Northern Isles Preliminary Analysis for the Orkney Islands and Shetland and Fair Isle regions was conducted separately due to the shorter time series available. The results should be interpreted with caution due to the limited data duration, but they offer an initial insight into the potential trends at Northern Isles Shorewatch sites and highlight the strength of Shorewatch in capturing early signals of change in cetacean presence.

Scottish Marine Regions (SMRs) were used as the framework for this regional analysis, chosen for their practical advantages, including their inclusive coverage of coastal waters. SMRs are well-established management units that align with marine conservation strategies such as species management plans and the National Marine Plan. They provide a useful structure for integrating cetacean monitoring data into broader marine management efforts. However, SMRs will not fully represent the distribution of mobile species, whose movements often extend beyond these boundaries. Alternative frameworks, such as Marine Protected Areas (MPAs) or Important Marine Mammal Areas (IMMAs), could offer additional conservation and management benefits by targeting critical habitats and migration corridors for cetaceans.

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The statistical models applied to the data performed particularly well for high-occurrence species, such as harbour porpoises and common dolphins, which were consistently observed throughout the study period. This allowed for the reliable detection of spatial and temporal trends and offered clearer insights into their seasonal patterns and overall distribution. For less frequently occurring species, identifying trends over shorter timeframes is challenging. To reliably track seasonal and interannual patterns, sustaining consistent Shorewatch effort over extended periods is essential. Long-term datasets will be necessary to draw more robust conclusions about these species' presence and distribution.


harbour porpoise *(Phocoena phocoena)*

Together, these strengths and challenges underline the Shorewatch programme's valuable contributions towards identifying temporal trends in cetacean occurrence in coastal waters and identifying specific regions that serve as important habitats, while also highlighting the need to tailor monitoring strategies to address conservation and management needs for particular species. The insights provided by the Shorewatch programme can also contribute towards tracking the effectiveness of marine conservation policies, such as those outlined in the Marine Strategy Framework Directive, by providing baseline evidence and early detection of changes in species' occurrence. Shorewatch data can also be used to help inform environmental impact assessments, including, for example, towards appropriately siting offshore developments.

To further enhance the breadth and depth of monitoring, there is significant potential for integrating Shorewatch data with other survey programs that provide different spatial and temporal coverage, such as SCANS, or with acoustic monitoring programmes. This integration could improve coverage, particularly in areas with limited visual survey opportunities, and provide further insights into (and potentially a more comprehensive understanding of) cetacean presence and activity. (See Annex 2 for more on data uses and caveats.)

The monitoring data collected through the Shorewatch programme can be used to assess critical threats to cetacean populations, such as increased vessel presence, entanglement risks, and the impacts of marine industrial development. By tracking cetacean presence and distributions in relation to these threats, Shorewatch can provide valuable data that can guide policy decisions and inform efforts to mitigate risks associated with human activities. Ultimately, by maintaining a broad-scale, long-term monitoring programme, Shorewatch can continue to support ongoing engagement, advocacy and conservation initiatives, which are aimed at ensuring cetaceans around Scotland are adequately protected and their habitats preserved for future generations.

bottlenose dolphin *(Tursiops truncatus)*

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5. Conclusion

By the end of 2023, over 1,000 trained citizen scientists had contributed to Shorewatch.

The Shorewatch programme demonstrates the vital role of citizen science in delivering a cost-effective, scalable contribution to coastal cetacean monitoring. With more than 13,000 volunteer hours by the end of 2023 and growing, Shorewatch provides robust long-term data that reveal seasonal patterns, multi-year trends, and regional shifts in species occurrence across Scotland's coastal waters.

This study shows how expanded site coverage and increased winter effort have strengthened the programme's ability to detect emerging spatial and temporal patterns, demonstrating its adaptability and improved capacity to address previous data gaps. The addition of new core sites and the first regional analyses have broadened the evidence base, offering clearer insights across regions and for less frequently recorded species, though sustained, well-distributed effort remains essential for improving model performance for rarer species.

Using Scottish Marine Regions provided a practical and policy-aligned analytical framework for analyses, while emphasising the need to consider different spatial frameworks to better accommodate highly mobile species. Shorewatch offers a useful and complementary dataset to detect changes in coastal cetacean presence, alongside targeted surveys of offshore areas. Both are needed to inform conservation management of highly mobile species, so integrating Shorewatch with wider research efforts, such as SCANS and acoustic monitoring, will further enhance temporal and spatial coverage and strengthen evidence used in marine policy, environmental assessment, and site designation.

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What Next?

The Shorewatch programme's future success depends on continued volunteer engagement, strategic expansion into emerging regions, strong partnerships, and sustained funding. As ecological and anthropogenic pressures intensify, Shorewatch remains a vital tool for tracking change and supporting collaborative efforts to protect Scotland's cetaceans.

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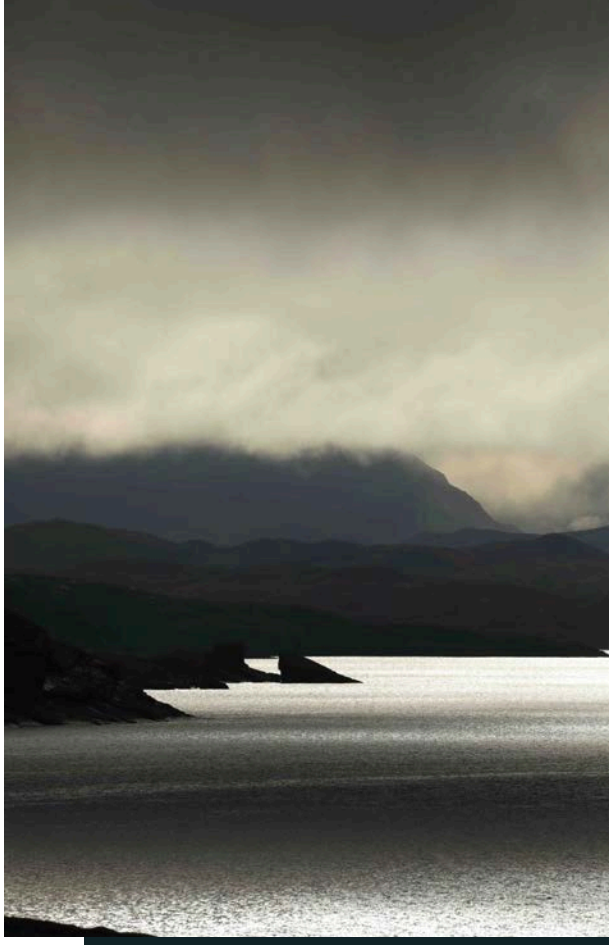

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Annex 1. Model specifications and results for each species: number of presences, response variables, explanatory variables selected by the models (in descending order of importance according to deviance explained), total deviance explained, adjusted R^2, correlation between the observed and the predicted values and distribution family used.

Analysis	Species	Presences (N)	Response variable	Explanatory variables	Deviance explained	R2 (adj.)	Corre-lation Obs. Pred.	Distri-bution
Core sites analysis	Bottlenose dolphin (Tursiops truncatus)	2370	Occurrence (0/1)	Site (as random effect) + Month + Effort duration + Effort start time + Sea state + Year + Visibility + Aspect	387%	378	874	Binomial
	Harbor porpoise (Phocoena phocoena)	954	Occurrence (0/1)	Site (as random effect) + Sea state + Effort duration + Month + Effort start time + Year + Aspect + Visibility	362%	28	739	Binomial
	Minke whale (Balaenoptera acutorostrata)	364	Occurrence (0/1)	Site (as random effect) + Month + Effort duration + Sea state + Visibility + Effort start time + Height + Year	462%	297	790	Binomial
	Risso's dolphin (Grampus griseus)	105	Occurrence (0/1)	Site (as random effect) + Effort duration + Month + Sea state + Year + Effort start time + Visibility + Aspect	476%	191	681	Binomial
	Common dolphin (Delphinus delphis)	261	Occurrence (0/1)	Site (as random effect) + Month + Effort duration + Sea state + Year + Visibility + Effort start time + Aspect	434%	199	654	Binomial
Regional analysis	Bottlenose dolphin (Tursiops truncatus)	3259	Occurrence (0/1)	Year + SMR + Year-SMR interaction + Effort duration Month + Effort start time + Sea state + Visibility	500%	521	900	Binomial
	Harbor porpoise (Phocoena phocoena)	1459	Occurrence (0/1)	Year + SMR + Year-SMR interaction + Effort duration Sea state + Month + Visibility + Effort start time	304%	277	717	Binomial
	Minke whale (Balaenoptera acutorostrata)	656	Occurrence (0/1)	Year + SMR + Year-SMR interaction + Month + Effort duration + Sea state + Visibility + Effort start time	404%	315	834	Binomial
	Risso's dolphin (Grampus griseus)	394	Occurrence (0/1)	Year + SMR + Year-SMR interaction + Effort duration Sea state + Month + Effort start time + Visibility	404%	248	771	Binomial
	Common dolphin (Delphinus delphis)	494	Occurrence (0/1)	Year + SMR + Year-SMR interaction + Effort duration Month + Sea state + Visibility + Effort start time	442%	295	781	Binomial
	Humpback whale (Megaptera novaeangliae)	144	Occurrence (0/1)	Year + SMR + Year-SMR interaction + Month + Effort duration + Visibility + Sea state + Effort start time	343%	135	574	Binomial
	White-beaked dolphin (Lagenorhynchus albirostris)	137	Occurrence (0/1)	Year + SMR + Year-SMR interaction + Month + Sea state + Effort duration + Visibility + Effort start time	472%	237	806	Binomial

Annex 2 - How to use this summary report and important caveats

This summary report provides a high-level overview of long-term trends, seasonal occurrence, and regional patterns of cetacean sightings from the Shorewatch programme. When used appropriately, these data can support evidence-based planning, environmental assessments, and conservation decision-making for developments and other human activities that may impact cetaceans. The report should be used in the following ways:

1. Interpreting Long-term Trend Data
Trend outputs for the most frequently sighted species can be used to:

- Identify long-term changes at the site or regional scale.
- Inform MPA monitoring and assessments (where data has been collected within or adjacent to an MPA).
- Highlight areas where consistent presence, increasing trends, or declines may inform local and/or larger-scale planning decisions and marine spatial plans.

2. Understanding Seasonal and Temporal Patterns
Temporal summaries (monthly or seasonal) help users to:

- Fill seasonal gaps in wider monitoring datasets, particularly during winter when offshore survey effort is limited.
- Identify peak periods of occurrence or sensitivity. This can help to support strategic scheduling of inshore/offshore development activities by identifying lower-risk periods for certain species.

3 . Using Regional Summaries (Scottish Marine Regions – SMRs)
Regional summaries included in the report allow users to:

- Put site-level results into a broader ecological and geographic context.
- Understand differences across coastal regions that may be relevant for cumulative assessments.
- Use regional trend information to support strategic planning across multiple SMRs.

4. Informing Development Planning
The summary report's outputs can help to:

- Inform the appropriate siting and timing of inshore and offshore development activities, particularly where trends indicate increasing presence or consistent high occurrence of sensitive species at certain sites and times of year.
- Support time–area mitigation measures, reducing disturbance and injury risks to cetaceans during potentially harmful activities.
- Provide evidence within Environmental Impact Assessments (EIAs) by offering systematic, long-term presence data for coastal waters.
- Provide additional context when assessing potential population-level relevance of proposed activities (e.g., trend data could be used alongside IAMMWG MU estimates).

These uses draw directly from the report's trend analyses, seasonal patterns, and regional summaries.

Caveats and Limitations

When interpreting the outputs in this report, the following limitations should be considered:

- Coastal Effort Bias: The report reflects data collected from coastal vantage points only. Offshore distributions are not represented.
- Species Coverage: Trend analyses are provided only for species with sufficient data. Less frequent species appear only in descriptive summaries.
- Underestimation of Occurrence: Effort only takes place during daylight hours and reasonable environmental conditions. Moreover, poor-condition sightings (sea state 5+ or visibility <1 km) are excluded from trend analyses to maintain quality, which may lower the apparent occurrence.
- Variable Effective Survey Area: The area visible at each site varies with environmental conditions, meaning spatial comparability across sites has limitations.
- Seasonal Effort Variation: Effort is systematic but not uniform. Some seasons and sites have higher observer coverage than others, which should be considered when interpreting seasonal patterns.

While the summary report provides robust trend, seasonal, and regional outputs, several analytical components are outside its scope. Users should be aware of the following limitations when interpreting the report:

- No abundance estimates: The data collected highlights species occurrence but has not been used to calculate abundance or population estimates.
- No spatial or mapping outputs: The report does not include raw spatial data, georeferenced sighting points, or GIS-ready layers. As a result, it cannot be used for producing maps or conducting spatial planning analyses without additional data access.
- Limited representation of rarer species: Species recorded too infrequently to support trend modelling are not included in analytical sections. Although they may appear in descriptive summaries, the report does not provide detailed analysis of these species.
- No fine-scale temporal analyses: The report summarises temporal patterns at broad (monthly/seasonal) scales only.
- No bespoke or site-specific reporting: The summary report presents findings at standard site and regional levels. It does not contain tailored analyses for particular development zones, planning areas, or priority coastal locations.
- No integration with external datasets: The report does not include modelling or comparative work using other monitoring sources (e.g., vessel surveys, acoustic datasets, environmental covariates).